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AN APPROACH FOR THE DISTANCE DELIVERY OF AFIT/LS RESIDENT DEGREE CURRICULA

THESIS

Mark C. Harris, Captain, USAF

AFIT/GIR/LSR/91D-9

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AN APPROACH FOR THE DISTANCE DELIVERY OF AFIT/LS RESIDENT DEGREE CURRICULA

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
in Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Information Resource Management

Mark C. Harris, B.A.
Captain, USAF

December 1991

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Special thanks is due Dr. Kathleen M. Fisher of San Diego State University, who provided the remarkable SemNet™ semantic network modeling software. Without SemNet™, organizing and understanding the abundance of distance education information would have been a much more formidable task.

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Mark C. Harris

Table of Contents

Page

Page

List of Figures

Figure		Page

Figure			Page

AFIT/GIR/LSR/91D-9

Abstract

This research developed an approach for adapting a resident graduate course, offered by the School of Systems and Logistics, for delivery to remote students through distance education resources and techniques. A review of literature—along with personal interviews of professionals from the fields of education, telecommunications, and technology—provided the information for a model of distance education and an assessment of AFIT's existing and near future resources that may be applied to distance delivery of graduate courses. Semantic network construction software was used to organize the information gathered for the distance education model. Key concepts were distilled from the conceptually multi-dimensional semantic network and presented in two-dimensional, hierarchical concept maps. The final distance education model presented concept maps of key concepts with text highlighting these concepts and organized in keeping with the structure reflected in the concept maps. AFIT's Academic Instructional System (AIS) provided a general procedural guideline for the design and development of graduate instruction. The research integrated knowledge of distance education—reflected in the distance education model—knowledge of AFIT's existing and near future resources, the AIS process, and knowledge of theories of cognitive activities into a course adaptation approach. The approach was demonstrated by application to a representative graduate course.

AN APPROACH FOR THE DISTANCE DELIVERY OF AFIT/LS RESIDENT DEGREE CURRICULA

Chapter I

Introduction

Chapter Overview

This chapter presents general background on distance education efforts at the Air Force Institute of Technology (AFIT) and on the knowledge representation systems used in the information gathering and conceptual modeling phases of this research. The research objective is stated, accompanied by a list of research sub-objectives. The chapter also addresses the scope of the study, its justification, and research assumptions.

Background

According to the AFIT School of Systems and Logistics (LS) *1991S/D Graduate Programs Handbook*, the purpose of the school is to "provide graduate degree programs and continuing education courses directed at the study of management systems developed to support Air Force and Department of Defense goals and objectives ...", and its graduate education mission is "to develop and administer fully-accredited graduate degree programs designed to provide selected qualified students with the opportunity to acquire and apply to the management of complex systems a variety of analytic, quantitative, behavioral, and decision-making concepts and techniques" (1:2).

In the past, AFIT has primarily offered only professional continuing education courses by distance education means. Most of these courses covered the undergraduate civil engineering and services, acquisition management, logistics management, and contract management topics which were most in demand at Air Force installations (40). Although the methods of delivery were predominantly correspondence by mail, text based, or video cassette based, some courses did incorporate interactive technologies such as the electronic blackboard with audio links (15).

Many educators and researchers believe some important characteristics distinguish graduate education from other forms of education. One frequently cited distinction is the higher levels of cognitive activity (analysis, synthesis, abstract thinking, evaluation, etc.) required of graduate students (13; 21). Another is the deeper collegiate atmosphere shared among graduate students and between students and the graduate faculty (21; 36; 43). This second distinction may partly be an outgrowth of the first. Higher level cognitive activities may require more interaction between the learner and instructor, and among learners (21; 43). This increased interaction leads to, and is reinforced by, a sense of community and shared purpose that is thought to enhance the educational process (29; 43). It is natural, then, that graduate educators might be inclined to question proposed educational innovations that could threaten the existence or quality of the collegiate community (29; 43). Since graduate educators often associate correspondence courses or strictly non-interactive media, such as audio and video cassettes, with distance education, any effort to win educators' willing support must address the issue of maintaining both spontaneous and planned interaction between learners and instructors and

among learners (29). The interaction desired is *real time* (i.e., immediate), as when two or more persons are engaged in a conversation in the classroom.

The term "real time" originated in computer science and means, in that context, "any system in which the processing of data input to the system to obtain a result occurs virtually simultaneously with the event generating the data" (10:340). The use of the term to describe process control systems in which "input data must be processed quickly enough to enable the results to be used as feedback information" (10:340) comes closer to the term's usage in a communication context, in which it involves immediate feedback. The general meaning of the term "real time interaction", as used in this research, is that characteristic of an educational delivery system which provides the opportunity for immediate feedback or communication between the learner and instructor (or automated instruction medium, such as interactive computer based instruction) or among learners. The key concepts in this definition are *immediacy* and *interaction*, where interaction is reciprocal action or communication between a learner and a source of instruction (instructional material or instructor), between learners and instructors, or among learners (46:955; 33:100-101).

Real time technologies may support *off-line* interaction (i.e., not during the transmission of a class session), such as telephone office hours outside of class time (13:4), or *on-line* interaction (i.e., during the transmission of a class session), such as two-way audio communication by phone during the class session. Other real time technologies that may be used in either on- or off-line capacities include communication by linked computers (15), video and/or audio links via satellite, and other electronic technologies like the electronic blackboard (18; 6:13) or the smaller electronic tablet (13:2) — devices which display on a surface at the destination site exactly what is being written or drawn at the source site. Fiber

optic networks are also capable of transmitting two-way real time voice and image communications (12:504).

Some technologies provide synchronous communication, enabling two or more parties to both send and receive simultaneously, as with a normal classroom conversation or a live teleconference in which two people may be both speaking and listening at the same time (48:16). Others provide asynchronous capabilities only, not unlike a citizen-band radio, which permit the user to select either a send or receive mode, but not both simultaneously (48:16). For practical purposes, both synchronous and asynchronous communications are considered real time, so long as the direction and pace of the asynchronous communication is controlled by the users and provides immediate feedback capabilities.

Distance education involving interaction between the learner and instructor can be accomplished by a number of real time and non-real time (delayed asynchronous) methods. Interactive technologies allow the instructor and students to communicate (13:4). Non-real time (but potentially interactive) technologies include well-known methods, such as correspondence by mail (conducted by the Extension Course Institute of Air University). Correspondence may be in hard copy, as with typed or written letters, forms, and tutorial study guides, or may be stored on magnetic media, such as audio cassette tapes and computer disks, or on magneto-optical media, such as erasable optical disks (23). Correspondence may also be via electronic mail (12:504-505). Another popular non-real time medium is the video cassette tape (23; 13:3). These technologies do not allow real time interaction between an instructor and students while the course is being broadcast live, a capability whose merits are widely debated (13:4).

A successful implementation of distance education requires matching educational needs with the available resources, instructional methods, and communications technologies (15; 40). Determining needs requires the acquisition of knowledge about the institution's mission, objectives, and resources, as well as knowledge about the customers' educational needs and the appropriate technologies and pedagogic techniques for delivery of the curriculum (15).

This research provides an approach for structuring the instructional delivery, by distance education technologies, of courses from the graduate programs of the AFIT School of Systems and Logistics. The approach comprises a synthesis of distance education methods and principles of academic instructional systems (AIS), matched to AFIT's existing or near future resources, to comply with AFIT's mission in meeting the needs of its customers within the Department of Defense (DOD). The approach consists of a structured representation of the entities, relationships, and propositions involved in the distance education delivery of LS graduate courses, with attention given to the need for learner-instructor interaction in many courses. While not every aspect of each graduate course requires real time interaction for successful delivery, the research aims to highlight ways of providing such interaction when appropriate.

The organization and presentation of the knowledge gleaned from the research, particularly the modeling of knowledge about distance education, required a knowledge representation method. Knowledge representation methods are used to organize knowledge into a coherent semantic and/or iconic (a graphic model or schema) form which other people can understand. Methods of knowledge representation may be semantic (written language and symbols), mathematical models (like formulas), graphic models, and combinations of these (for example, charts, graphs with labels, mathematical plots, etc.).

The research employs concept mapping as a knowledge representation technique for the model of distance education knowledge because:

(1) it is relatively simple to use and interpret;

(2) it can represent a system in terms of its components, their properties, and the relationships between them;

(3) it facilitates the identification of the key concepts in a knowledge domain; and

(4) it can present concepts in a manner which employs both semantic and graphic forms, enhancing comprehension of the information being communicated (31:7-9, 46).

Justification

AFIT is not currently achieving the student throughput which would constitute the full satisfaction of its mission to provide education to DOD agencies (21). More than half of the reported educational need, in terms of personnel requiring particular instruction, goes unsatisfied (21). Aside from this straightforward need to increase throughput, there is the possibility that legitimate, but unreported, needs may remain unreported due to potential customer organizations' perceptions of AFIT's lack of educational capacity (21).

The need for graduate education of Air Force and other DOD personnel is increasing for at least three reasons. First, the complexity of the methods and technologies required to meet defense objectives is continuously increasing. Second, the resources (fiscal, materiel, and personnel) to meet these objectives are decreasing. Third, the new acquisition professional certification programs established by DOD have increased the demand for additional classroom seats (15; 21) These trends, combined with AFIT's existing educational backlog and

resource shortfall, interact to aggravate the demand to increase student throughput. Meeting these customer demands—both the unserved backlog and the increase due to work complexity—will require AFIT's education providers not only to do work previously done by others (due to downsizing), but to significantly increase AFIT's throughput to serve new educational needs. Solutions will not likely be found in simply working harder. Different means will be required which are more resource-effective and capable of sufficiently addressing the increasing complexity within the defense environment. Real solutions will not be restricted to resident instruction or to the limited forms of distance education used by some components of AFIT in the past.

Objectives of the Research

It is the purpose of this research, given a knowledge of distance education methods and principles of academic instructional systems, to demonstrate how AFIT's existing or near future resources can be applied to effective real time distance delivery of an LS resident course that requires interaction between instructor and students.

To satisfy this objective, the following sub-objectives must be met:

1. Develop a model of the field of distance education.
2. Develop an understanding of the AIS process.
3. Identify AFIT's existing or near future resources which may be directed toward distance education, including support for real time interaction.
4. Integrate the distance education and AIS models with existing resources into a media selection approach.

5. Identify a representative interactive LS graduate course for potential delivery by distance education and apply the media selection approach to the sample course.

6. Present conclusions and recommendations, identifying potential problems with the media selection approach and recommending ways to overcome the problems. Identify strengths of the approach and recommend further actions.

Scope of Study

This study addresses the development of a real time, interactive, distance education delivery approach for a representative course from the master's degree programs currently being offered to resident students of the School of Systems and Logistics. The approach does not address professional continuing education, School of Engineering, or School of Civil Engineering and Services curricula.

The approach was designed to provide a tool that curriculum developers could use to match candidate courses (those involving significant interaction) to an available distance delivery vehicle. It was not intended that any entire degree program be converted to distance education delivery.

An objective of the study was to provide a distance education approach that was feasible within AFIT's existing or near future resources. The research was not intended to present a cost analysis of using distance education modes.

Assumptions

The research assumed:

1. The fiscal environment within which AFIT exists will become more restricted in the foreseeable future.

2. The technological and conceptual complexity of working effectively and efficiently within the Air Force will continue to grow.

3. The need to provide USAF military and civilian personnel advanced educational opportunities will continue to increase.

4. The means to satisfy the need to educate more people, without proportionately increasing the costs, is not to be found in either traditional resident instruction or in the distance education technologies historically used by AFIT.

Chapter II

Methodology

Chapter Overview

This chapter discusses the methodology used to approach the research problem. The steps of the method, outlined below, include information gathering from literature and interviews, organization of the information, conversion of the distance education information into a conceptual model, identification of AFIT's distance education resources, description of the AIS, design of a media selection approach, application of the approach in selecting media for a sample course, and recording conclusions and recommendations. The following chapters contain the results obtained by applying these methods.

Developing the Conceptual Model of Distance Education

The author gathered information for the model through literature review and interviews, then organized the collected information into semantic networks of concepts (objects and events) and propositions (concepts linked by relationships)*. This knowledge integration process progressed in two phases:

1. Organization of the information into a semantic network structure, facilitated by SemNet™, a beta version of a software package provided by Dr. Kathleen M. Fisher of the Center for Research in Mathematics

* The collected distance education information is presented at Chapter III.

and Science Education & Department of Natural Science at San Diego State University.

2. Conversion of the disk based SemNet™ network frames to more traditional concept maps (as described by Novak and Gowin [37]).

Concept mapping and semantic networks have, to some extent, a different focus (16:10). They "take a different cut through the same knowledge structures" and can often be used together (16:10). SemNet™ permitted the organization of individual propositions, concepts, and relationships into the network without first having to draft the structure of the completed network. The structure of the network emerged as more propositions were supplied. This organic, *emergent* approach to describing a knowledge system offered a number of advantages over design-oriented hierarchical approaches (19; 20). Once the semantic network for distance education was completed, conversion of its related clusters of concepts to concept maps was fairly straightforward.

Conversion of the SemNet™ frames to concept maps was desirable because the screen arrangement protocol of SemNet™, while very useful for the automated multi-dimensional networks SemNet™ portrays, are not as well suited for two-dimensional display as are concept maps.

SemNet™ convention places key concepts in the center of each page, with related (not necessarily *subordinate*) concepts arranged around them. While this works well for the conceptually multi-dimensional electronic networks, it is a very cumbersome approach for the two-dimensional concept maps. Therefore, in converting the SemNet™ network frames to conventional concept maps, this research maintained the convention, recommended by Novak and Gowin (37:15), of a top-to-bottom, semi-hierarchical presentation of concept maps, with

subordinate concepts displayed below key concepts. The individual pages of the distance education conceptual model* permit referencing between and among related pages by following key concepts across pages. This cross-referencing is facilitated by a directory of concepts that accompanies the concept maps.

Identifying AFIT's Distance Education Resources

The description of AFIT resources that may be applied to the distance delivery of LS graduate courses was based on interviews of knowledgeable personnel. The description reflects technologies used in present distance education programs, such as SYS 200 and MATH 525-535**. The description also reflects technologies used in other current and planned distance education programs at AFIT. Areas investigated include: (1) available media technology, (2) facilities from which to offer courses, and (3) personnel to design and instruct the courses. The information collected was organized and presented at Chapter IV.

Description of the AFIT Academic Instruction System (AIS)

The research described general instructional design concepts (Bloom's Taxonomy) upon which the AIS is based. It then described the AIS itself, discussing the application of AIS to distance delivery design.

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* The complete conceptual model is presented at Appendix B.

** LS is studying a possible conversion of the Statistics I and II sequence to exportable form. The first phase, a trial, consists of a telecourse version of Introductory Statistics offered simultaneously in four AFIT classrooms. One-way video, two-way audio interaction is provided. (*Interview of B. Williams* [49])

Identification of a Sample Course

Demonstration of the distance delivery design approach required the selection of a course on which to apply the media selection approach. The researcher reviewed School of Systems and Logistics course descriptions (provided by the LS graduate programs office), seeking to identify a course that would adequately test the media selection approach. The criteria applied in selecting the course included: (1) researcher familiarity with the content and learning objectives; and (2) a reasonable requirement for interactive activities. The second criterion was assessed based on the researcher's experience in taking the course, on the instructor's guidance, and on an a preliminary analysis of the stated learning objectives of the course.

Selection of a Distance Education Delivery Method for a Selected Course

Designing a selected course for distance delivery required the consideration of a number of factors. These factors, or criteria, were represented in the distance education conceptual model, the presentation of AFIT's existing and near future resources applicable to distance delivery of resident courses, and the discussion of AIS. The characteristics of the particular course were compared to these three bodies of information, first, to determine if distance delivery was advisable after all and, second, to devise a specific delivery plan for that course. Figure 2.1 depicts this process.

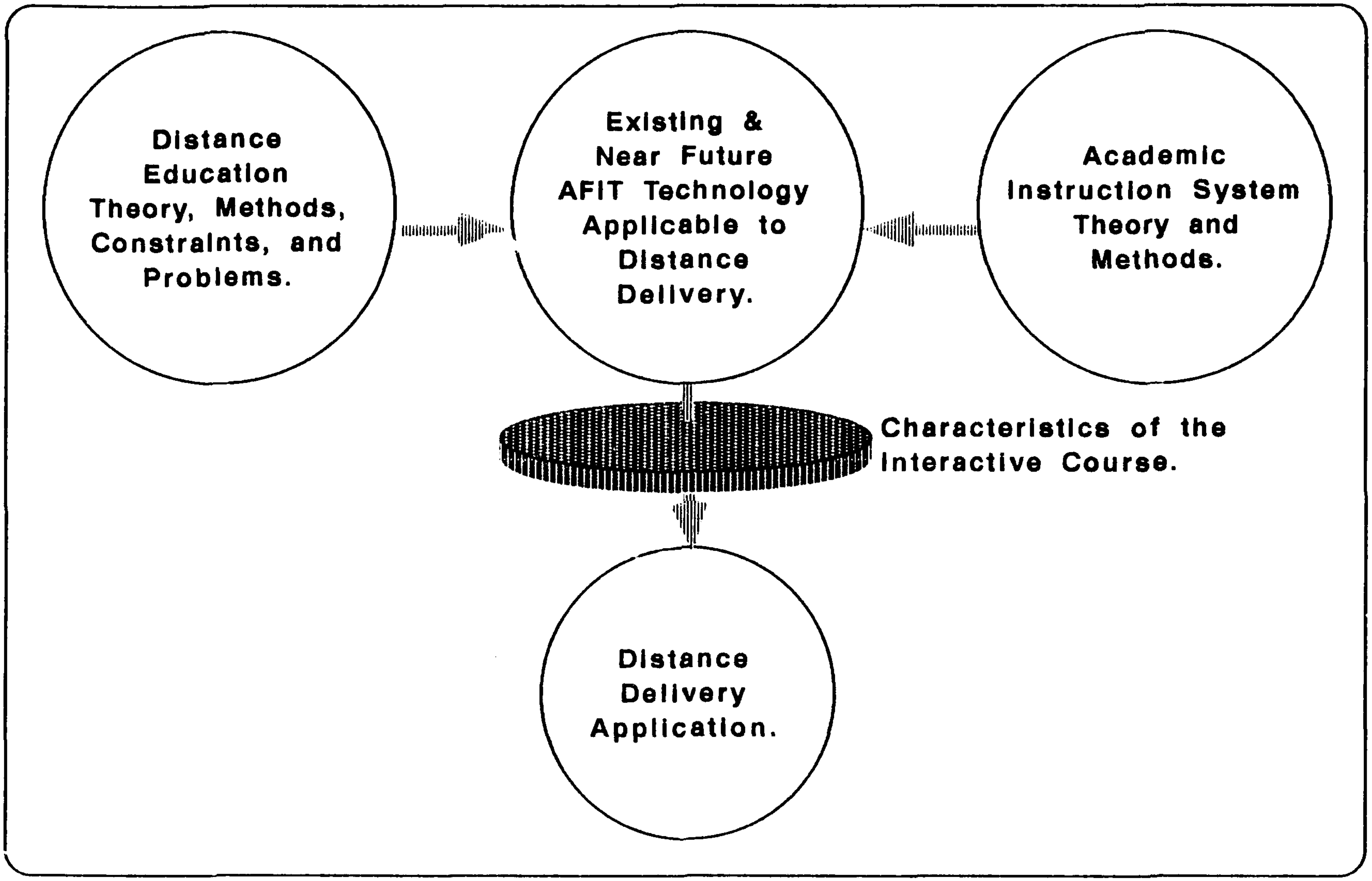

Figure 2.1. The Distance Education Design Process

The distance education delivery method determined or described:

a. AFIT resources (available communications technology, media, and personnel), determined through interviews;
b. desired delivery modes (i.e., one- or two-way video, one- or two-way audio, computer conferencing, etc.), determined through application of the media selection tool; and
c. desired interaction ratios (determined both from the distance education model, review of the learning objectives of the example course, and from interviews of the instructor of the course).

Conclusions and Recommendations

Conclusions were presented, accompanied by supporting rationale based on the research. A recommendation was derived for each conclusion.

Chapter III

Distance Education

Chapter Overview

This chapter presents an overview of the field of distance education. Two integrated means of knowledge representation, text and concept mapping, are employed. The chapter provides textual material derived from a survey of literature and from interviews. The text is organized to parallel the structure of the conceptual model of distance education presented in its entirety at Appendix B.

Introduction

Topic Statement.

The delivery of educational instruction to student sites which are geographically separate from the providing institution has been accomplished in a number of different ways. The particular groupings of course content, presentation methods, and media technologies referenced in this review reflect some of the ways educators have designed or adapted courses for distance delivery.

Topics and Method of Treatment.

This overview of the field of distance education presents information drawn from literature and interviews. The gathered knowledge was organized in

a two-phase process. First, the researcher entered concepts and propositions* into the SemNet™ semantic-iconic modeling software. Then the researcher converted the most salient portions of the resulting knowledge model into conventional concept maps (as described in Novak and Gowin, 1984 [37]), which are more suitable for printed representation than are the computer screen graphics generated by the SemNet™ software.

The root (highest) level concept map (Figure 3.1) to emerge from the second phase of knowledge organization is presented below. It provides both an overview of the key concepts in the field of distance education and a structural map describing the organization of this chapter. The root map identifies the key concepts associated with distance education: distance, the institution's goals, the learner, the instructor, interaction, presentation (or instruction), the course content, and the media technology employed in delivering education at a distance.

The following discussion provides a definition of distance education (i.e., concept 0), then progresses through sections describing each of the remaining eight fundamental concepts (concepts 1.0 through 8.0). Discussions of each fundamental concept will begin with a concept map offering an overview of knowledge pertaining to that concept, then present written material organized in accordance with the provided concept map. Concept maps representing this second level of detail (i.e., maps whose highest node is a concept with a two-position index number, such as 3.1) will be the most specific presented in this chapter. The reader may use the concept index numbers (the numbers to the top and right of the concept bubbles in each map) to reference the complete concept model presented at Appendix B.

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* *Propositions are "two or more concept labels linked by words in a semantic unit" (37:15).*

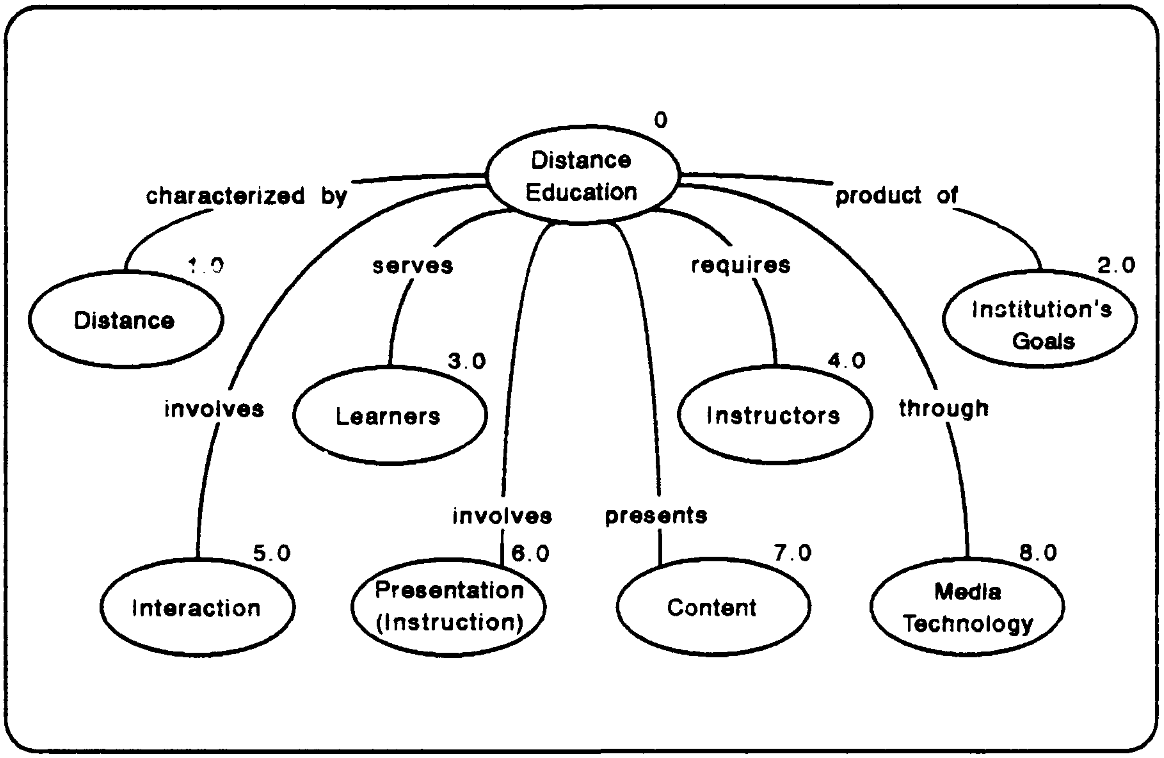

Figure 3.1 Root Map: a Conceptual Overview of the Field of Distance Education

Concept 0: Distance Education—A Definition of the Field

The literature contains a number of definitions of distance education or distance learning. Bruce Barker writes that distance learning is "the transmission of a master teacher's lessons from a host site to receiving sites via telecommunications" (6:13). This apparently intended exclusion of less masterful instructors and facilitators is not universal in the literature. Nor is the exclusion of non-telecommunications media, such as correspondence by mail.

Börje Holmberg offers a description of distance education which, he states, has been widely accepted. He writes, "*distance education* covers the various forms of study at all levels which are not under the continuous, immediate supervision

of tutors present with their students in lecture rooms or on the same premises, but which, nevertheless, benefit from the planning, guidance and tuition of a tutorial organisation" (22:127). This concept includes all forms of remote study and replaces Barker's "master teacher" with the more generic "tutor," in the British sense, which could be an instructor or facilitator.

Michael G. Moore is more concise, stating, "In distance education the person, persons or institutions providing instruction are separate either in place or time, or both, from their learners" (35:13). Moore focuses on the separation aspect of the field. Interestingly, he allows that separation in time alone could identify a distance education application. This would mean that students reviewing videotapes or audio cassettes of classes they missed due to illness could be viewed as participating in distance education.

For the purposes of this research, distance education is any form of deliberate education or study in which the principal source of instruction is removed from the learner either physically or in time. The instructor is the primary provider of instruction, as opposed to tutors (in the American sense), who do not have to be—but certainly may be—physically removed from the learner, and facilitators, who are usually physically present at the remote classroom. In the case of a human instructor, the source of instruction is distinct from both the content and the delivery medium.

In the case of computer implemented or computer based instruction (CBI) where there is no access to a live instructor, the distinction between source and medium is less clear. With the use of media not accompanied by opportunities to interact with a human instructor (such as CBI and programmed texts), the ultimate source of instruction is the expert whose knowledge and presentation skills are incorporated in the instructional package. The computer disk, like the text or

magnetic recording, is simply a medium. CBI does, unlike text based instruction, provide a sense of interaction not completely unlike interaction with a living instructor. Of interest to this research is that domain of distance education which involves on-live interaction with a source of instruction, whether a human instructor or a recorded lesson, such as a CBI program on a local or remote computer system. Also of interest, in a secondary sense, are forms of recorded instruction used in an off-line mode entirely at the receiving site, such as video cassettes, which may augment the presentation of graduate material.

Concept 1.0: Distance

Distance incorporates at least three subordinate concepts, each having to do with the *separation* between the people involved in the educational process. These are time separation, space separation, and psychological separation.

Concept 1.1: Actual Distance.

The definitions of distance education given above reflect *actual distance* (i.e., measurable separation in space and time [35:13; 22:127]).

Concept 1.2: Perceived Distance.

Many factors (educational context, learner's attitude and maturity, degree and type of communication, delivery medium, etc.) interact to form the learner's perception of separation (i.e., *psychological separation*) from the instructor. Assuming a viable distance education delivery system exists, perceived distance

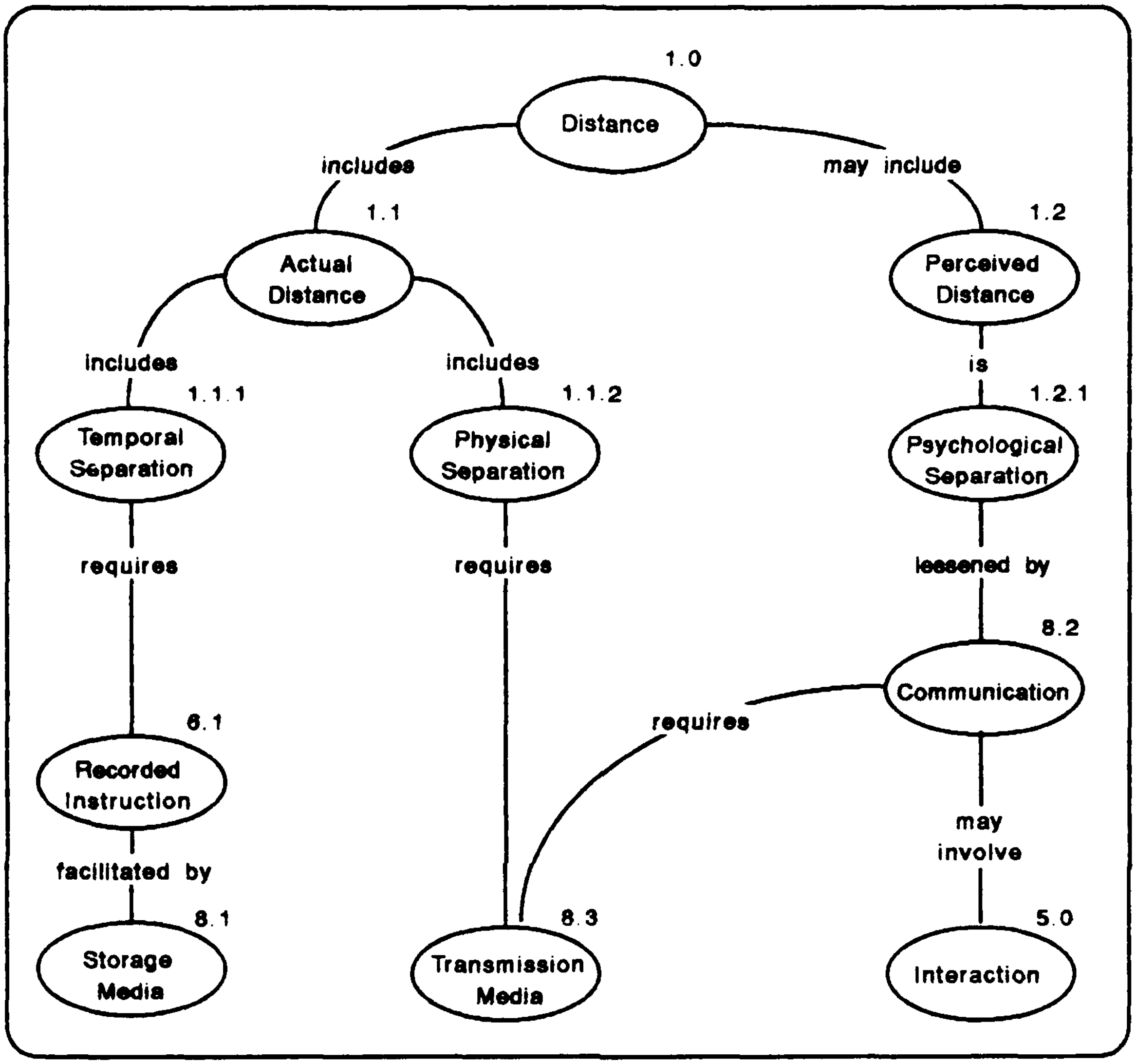

Figure 3.2 Distance

stands to exert greater influence on the educational experience than does actual distance (8:105). The learner's perception of distance may be uncorrelated to actual distance (21). A student sitting two classrooms down from the instructor and receiving live instruction over a local cable television system may *feel* more separated from his instructor than does another student who is separated from her instructor both by a thousand miles and by time (as when reviewing

recorded instruction [13; 26]). Existing distance education technologies, particularly those telecommunications technologies involving real time interaction and video, can help reduce perceived distance (8:105; 21).

Concept 2.0: The Institution's Goals

A spectrum of views exists as to when distance education is appropriate. On the more restrictive end of the spectrum is the perspective that sees "distance education systems as providing standard, for credit, courses covering the same material as their parallels on-campus, but doing it at a distance through some form or forms of communications technology and media" (8:17). The opposite end of the spectrum includes those who find broader purposes and applications for distance education (8:17).

Whenever quality instruction is available at a time and place convenient to learners, they generally prefer direct, face-to-face instruction (8:103). Distance education is a viable alternative in situations where either the location or the timing of the instruction is inconvenient or impossible for the learner (8:103). While it can be readily adapted to standard, for-credit courses, distance education's full potential includes the capacity to:

> improve access to instruction/training, provide access to subject matter experts and role models, provide interaction and joint activities with students at other locations, and increase access to information and instructional resources. (8:103)

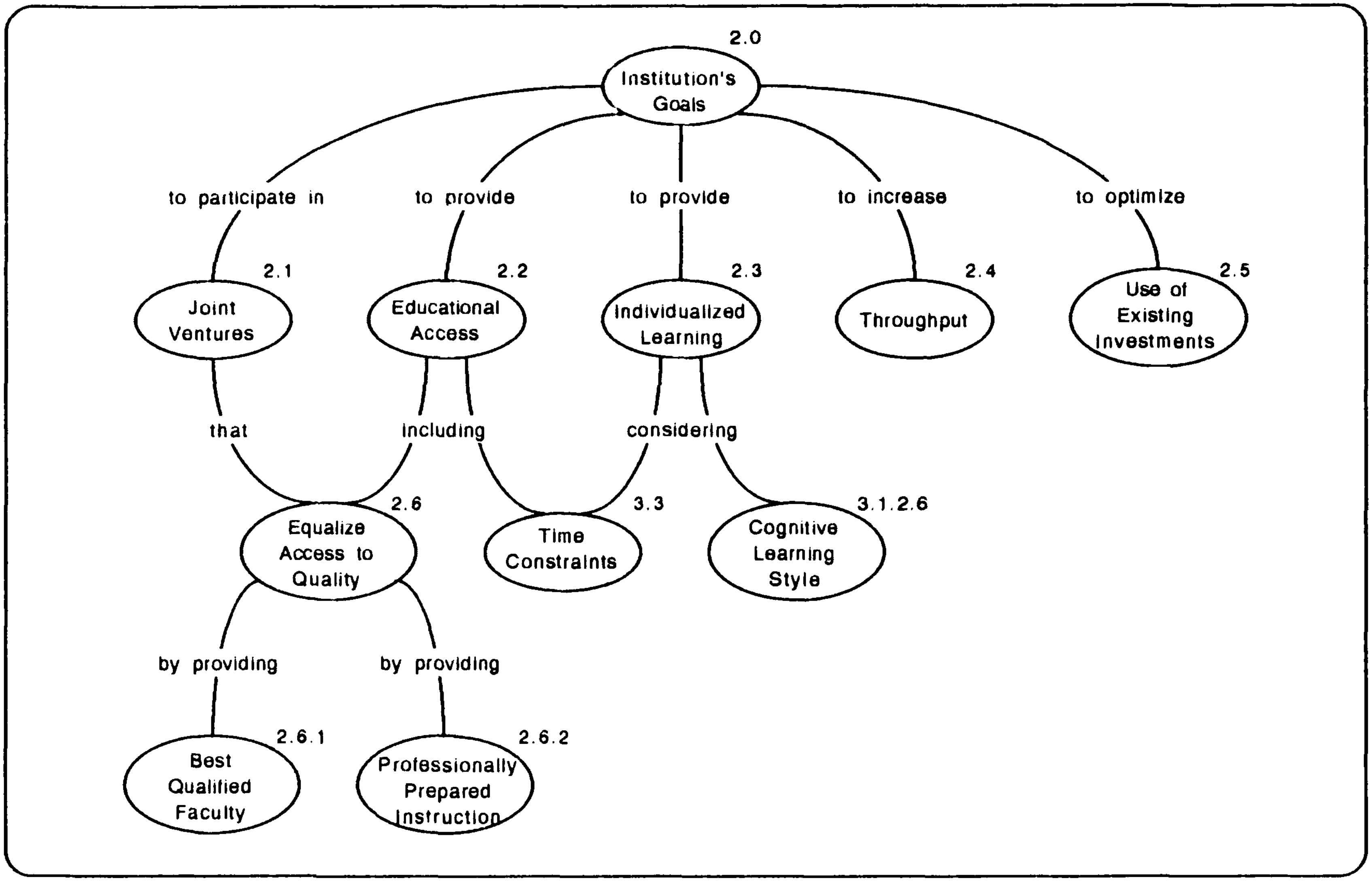

Figure 3.3 The Concept, "Institution's Goals"

In a study sponsored by the American Assembly of Collegiate Schools of Business (AACSB) in 1989, Andre Delbecq and Debra Scates noted seven primary goals or motivations that lead educational institutions to use distance education.

Concept 2.1: Participate in Joint Ventures.

Educational institutions may desire to increase cooperative ventures among themselves and other schools and corporations (13:2). This permits students to see applications of the knowledge and skills they are learning and enables companies with geographically dispersed operations to "equalize educational access" for their employees (13:2). Many organizations already possess teleconferencing facilities which could be put to educational use (13:2).

Concept 2.2: Provide Educational Access.

Institutions may be motivated to provide educational access "for students who would not have the opportunity to undertake education through residential programs," including full-time workers, rural people, the handicapped, the elderly, prisoners, military personnel, and business executives with unpredictable schedules and frequent travel obligations (13:2).

Concept 2.3: Provide Individualized Learning.

Delbecq and Scates' state a powerful motivation for using televised courses (broadcast or taped) is that of accommodating the peculiar learning styles and time constraints of individual students (13:2). Goals relating to time

factors include both accommodating the learner's daily schedule and having a course "available at a key point in a student's career" (13:2). Institutions may also seek to meet the needs of individuals who, apart from any time constraints they may have, simply prefer and perform better in an individualized learning mode (13:3). "Televised courses hold potential for the most highly individualized instruction at times of a learner's choosing compatible with a self-directed style of learning," write Delbecq and Scates (13:3).

Concept 2.4: Increase Throughput.

Institutions of higher learning can enlarge their markets, not only by enrolling more students in *degree programs*, but also by enrolling distance learners in *non-degree and/or for-credit courses* (13:3). The latter group of students includes those seeking personal development and those needing "to access a particular area of specialized information pivotal and useful with respect to an immediate career objective" (13:3)

Concept 2.5: Optimize Use of Existing Investments.

Educational providers seeking optimal use of existing investments may be attracted to distance education (13:2). Many individual institutions and state university systems wish to make the most of existing television facilities and networks that were originally associated only with engineering education or adult continuing education efforts (13:2).

Concept 2.6: Equalize Access to Quality Education.

A fifth, and similar, motivation is "to allow students to access specialized faculty competencies" at more than one university (13:2). The ability to learn from outstanding researchers and educators contributes to *equalizing quality educational opportunities* (13:2). Cooperative ventures between institutions, usually driven by "rising costs in higher education," present the opportunity to share the cost of a knowledge resource—a leading academic or professional personality (13:2-3). The authors noted that there has been much talk about sharing costs and resources among universities, but considerable resistance to such a fundamental administrative change (13:2-3).

Concept 3.0: Learner

The distance learner may be understood in terms of her personal traits; the control he or she can exercise over own educational process; interactions with the learning material, other learners, and instructors; and time constraints.

Concept 3.1: Personal Traits.

Learners are characterized by personal traits which affect the degree of self-direction and control they can successfully exercise in the learning environment (18:20). These traits include intellectual ability, learning skills, "attitude, emotional maturity, cognitive style, self-concept, ... motivational level" (18:20),

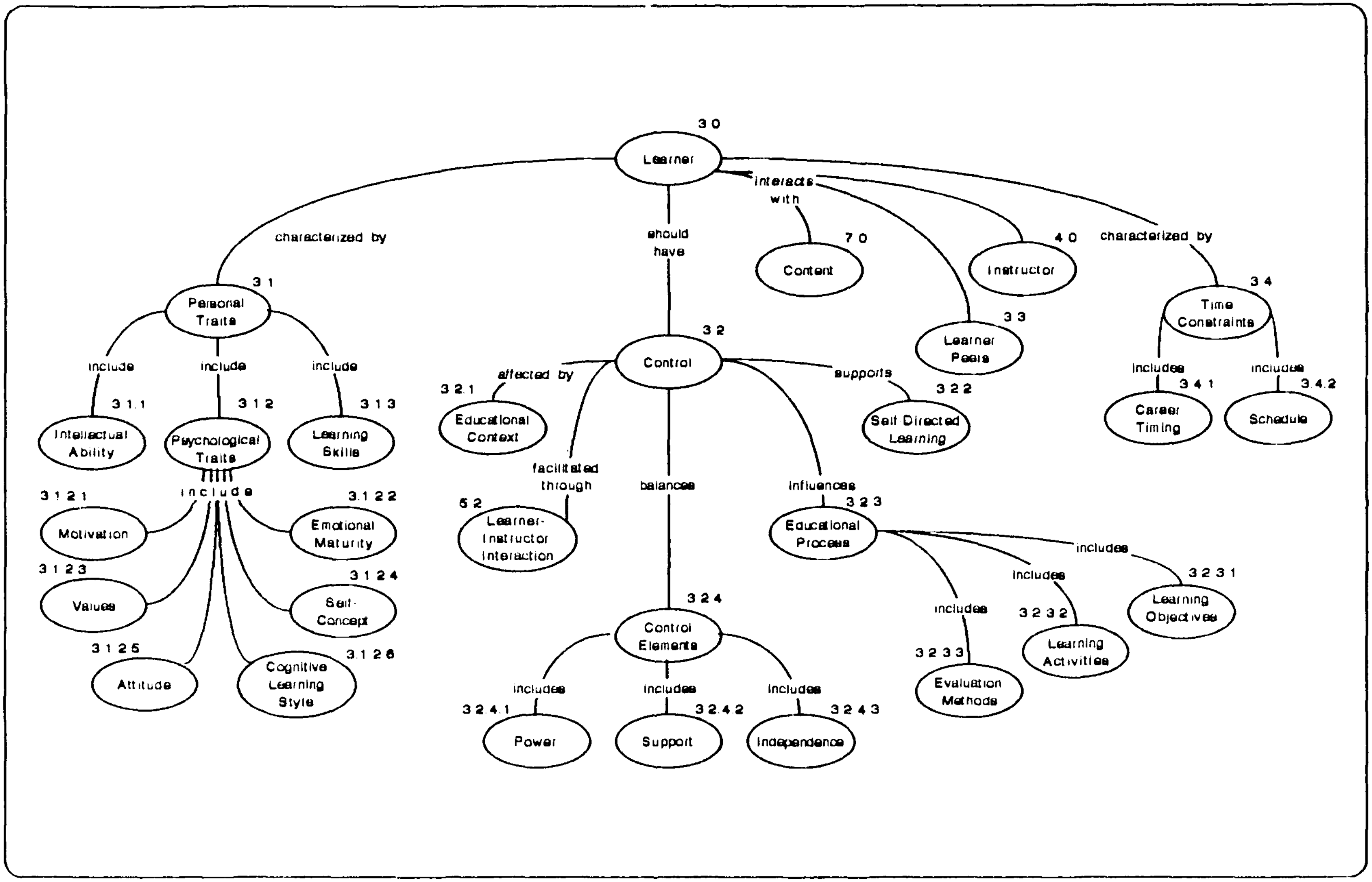

Figure 3.4 The Concept, "Learner"

and personal values (33:101-02). Personal traits are highly variable among learners and may change for an individual learner. The educational process can be managed in ways that encourage positive development and application of the learner's personal traits (18). Such approaches emphasize greater learner control of their education (18).

Concept 3.2: Control.

D. R. Garrison and Myra Baynton originated a conceptual model (Figure 3.5) in which student control of the learning process is determined by a balance

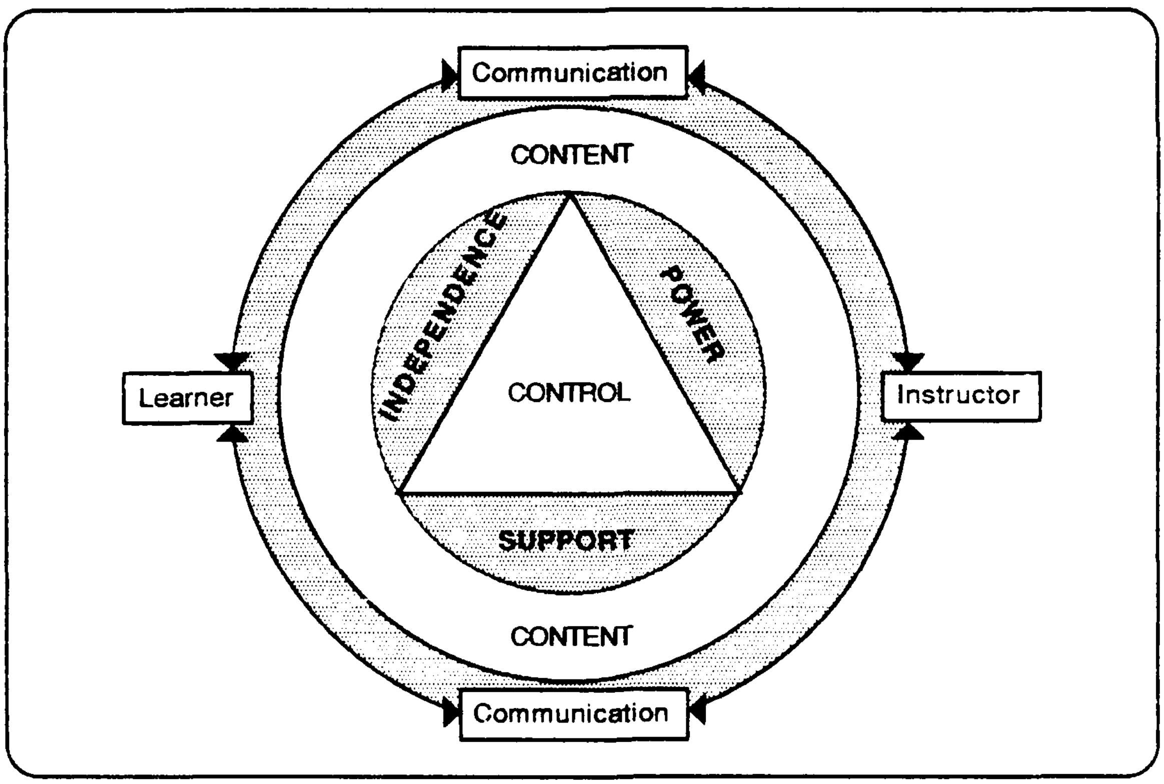

Figure 3.5 The Control Concept (18:16)

of three dimensions—"independence, power, and support" (18:16). Control is defined as the

> opportunity and ability to influence, direct, and determine decisions related to the educational process. ...achieved only by striking a balance between independence and other basic elements (i.e., power and support) in the learning process through the process of two-way communication between teacher and student. (18:18)

These authors argued that while much attention had been given to the concept of *independence*, which is generally considered to be "the degree of control learners exert over the context and method of their learning", control and independence are not synonymous (18:16). The development of learner independence and self-direction has widely been held as a primary objective of adult and distance education, but there has been little agreement about the meaning of independence, how much of it is desirable, or how independent behavior is best cultivated in learners (18:17). The encouragement of independent behavior, if isolated from the other elements of control, is not useful in distance education, since it omits the critical variable of interaction with the instructor (18:17).

In the context of education, independence is the freedom to shape one's own educational process, i.e., "the freedom to choose one's learning objectives, learning activities, and methods of evaluation" (18:19). Independence assumes the availability of alternatives, learner awareness of the alternatives, and freedom from either coercion or restriction in selecting from among alternatives. As a philosophical perspective, independence assumes an adult (i.e., mentally and emotionally mature and autonomous) learner, and posits that educational processes which fail to incorporate the autonomy of the adult learner are actually

designed to maintain a highly directive (parental-child) relationship between the instructor and the learner (18:19).

The legitimate question of whether learners are "capable of assuming the responsibility of choosing and reaching educational goals" introduces the element of *power* (18:19).

> Power is the ability or capacity to take part in or assume responsibility for the learning process. Without the requisite intellectual ability, study skills, or motivation to be involved independently in a learning process the individual cannot be in control of the learning situation. (18:20)

If independence is viewed as the philosophical aspect of control, power is the psychological dimension. It reflects several of the learner's personal traits, including cognitive style, emotional maturity, motivation level (incentive to learn), attitude, self-concept, and skills (18:20). All of these are necessary if the learner is to approach, persist in, and complete a program of learning (18:20).

Support is "the resources the learner can access in order to carry out the learning process" (18:20). These resources include courses, teachers/facilitators, course materials, experts, reference materials, media, financial assistance, emotional support, etc. (18:20). The instructor's and facilitator's roles in providing or coordinating support is crucial for increasing learner control of the learning process (18:20).

Views on support roles center around the type of relationship that exists, or should exist, between learner and supporter (instructor or facilitator). There are two types of supporter influence on learners (18:21): (1) assisting the student in making decisions by providing suggestions, advice, and information; and (2) managing, controlling, and directing the interaction (18:21). Garrison and

Baynton quote A. Tough: "The distinction between help and control is important, because it helps us realize that a learner can receive a great deal of help without giving up any of his control or responsibility" (18:21). Real support enhances rather than diminishes learner control (18:21).

Directly affected by distance, support is "the structural dimension of control ... primarily concerned with how programs are structured and delivered to the individual student" (18:21). The greater the accessibility and availability of resources, the greater the potential control the learner possesses (18:21). Support in distance education also depends on the technology used to mediate two-way communication (18:21).

Control is a complex and dynamic process. The degree of control exercised by the learner can, and should, change based on individual needs and the educational context (18:18). A true picture of control can only be obtained through considering all three elements—independence, power, and support; to evaluate any element in isolation disturbs the balance and gives a false impression of control (18:18). Real control gives the learner "the freedom to explore possible learning objectives, the power to handle a learning activity, and the support necessary to complete the educational experience" (18:18).

"Communication is the means for the integration and balance of the components in the educational transaction" (18:24). It occurs in two phases. The first, or *planning* phase, guides negotiation of program structure and development, including negotiation of content and learning objectives, establishing of learning activities, and determination of evaluation procedures (18:23, 25). The second phase, *dialog*, requires the availability of the instructor "to answer specific questions and support the instructional process" (18:23). Garrison and Baynton reference Moore's conceptualization of the role of

communication variables in determining the effectiveness of distance education. These variables, structure and dialog, provide a measure of the *distance* involved in the educational interaction (18:23).

> Dialog represents communication during the instructional transaction (learning phase) and is concerned with the student's intellectual, physical, and emotional needs for learning. Structure, conversely, is concerned with the preparation and flexibility of the program. It also appears to reflect the degree to which the teacher determines the objectives, content, and strategies. (18:22).

Instructor-learner negotiation of structure must occur prior to the instruction (18:23). The quality and form of instructor-learner communication determine the degree of learner control (18:24).

Communication and its effects in determining control are characterized by its purpose, by its means (i.e., how it is mediated), and by who initiates it (18:24). The initiator "is in a more advantageous position to control the educational transaction" (18:24). Pacing is an example of the instructor exercising control by initiating communication to set deadlines (18:24). Since initiation concerns all three dimensions of control, it helps determine the balance among independence, power, and support (18:24).

Two other important issues are communication frequency and immediacy (18:25). Contact may be very frequent, moderately frequent, or infrequent; scheduled or as needed; and instructor-determined, learner-determined, or determined by both (18:25). Immediacy "how promptly feedback is received"—is determined by the communication medium (18:25).

"The communication process high in frequency and immediacy has greater potential for control by the student than communication characterized by low frequency and immediacy" (18:25). The technologies selected to mediate

distance education affect communication (interaction) between instructor and learner (18:25). "Telecommunications media such as teleconference or telephone provide more immediate feedback than correspondence" (18:25).

Concept 3.3: Learner Peers.

The distance learner, unless participating in independent distance education, will have learner peers—other students enrolled in the same course(s) at the same time—either at the same location or at separate locations from the learner (21; 33). Interaction with peers may be important for the learning process (5:13; 33).

Concept 3.4: Time Constraints.

As mentioned in several other parts of this research, time constraints are typical of the distance learner (8:9; 13:2). These include scheduling constraints arising from employment and spatial separation, as well as the critical timing of educational opportunities in the learner's career (13:2). Time constraints should be considered in designing a distance education program (13; 26; 29).

Concept 4.0: Instructor

The distance instructor is the principal source of expertise and learner support (18:20-21), providing progress feedback, counseling, encouragement, and reality testing (33:101-02). The instructor will often be the distance course designer (13; 21). He or she may require additional training in instructional

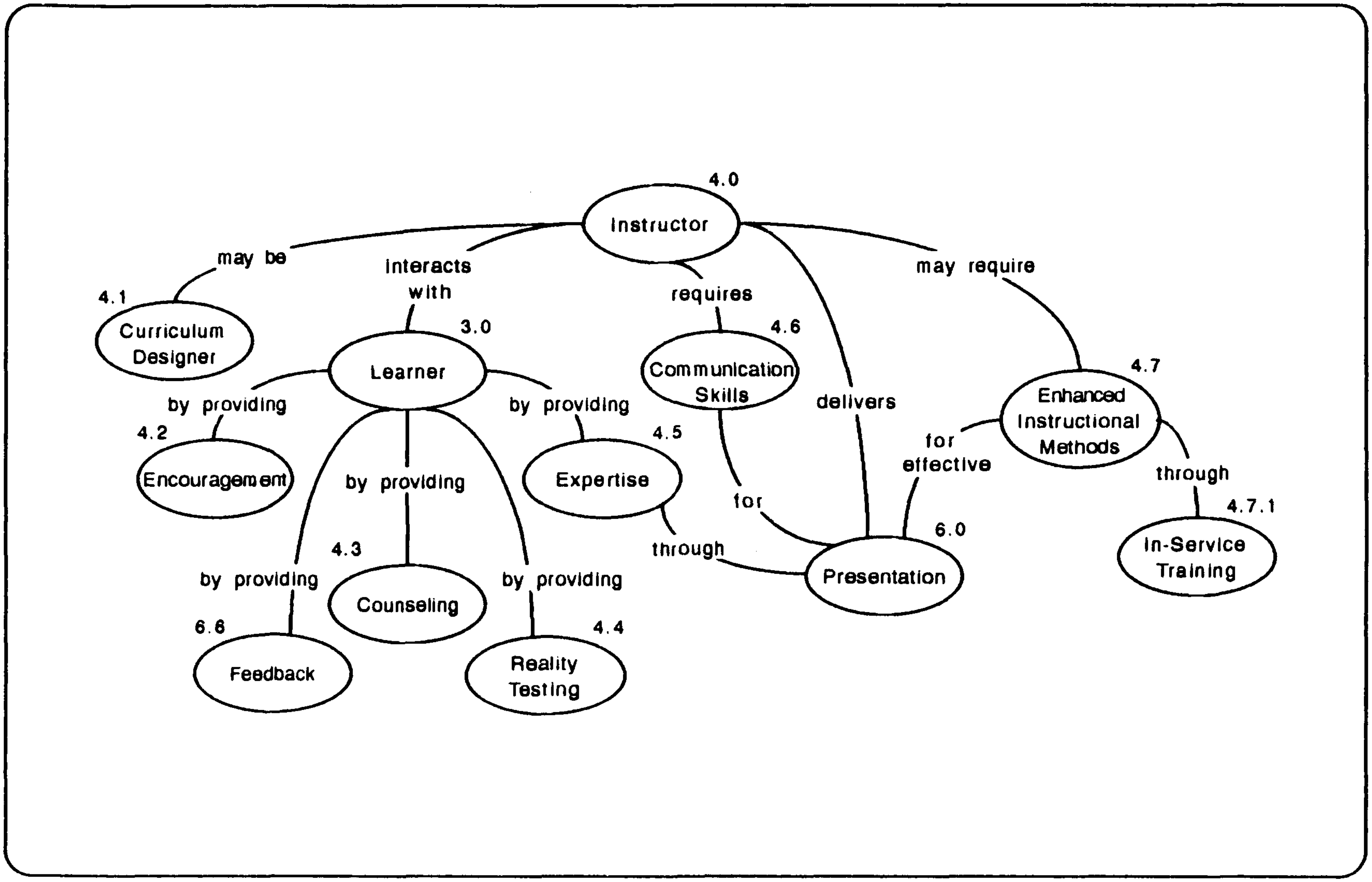

Figure 3.6 The Concept, "Instructor"

methods and related matters (learning theory, media and materials, communication methods, questioning and feedback techniques, group coordination and team building, and specific technologies [8:62]). In-service training should be provided to keep distance instructors' skills sharp (21).

There are at least two views on the appropriate *support* roles of instructors and facilitators. Garrison and Baynton quote Holmberg's *Growth and Structure of Distance Education*, relating that support "means treating students as potentially independent people to whom it is left not only to decide, but expressly to state, if and to what extent they want support and advice" (18:20). This view says to *give learners what they ask for*. Another perspective says *give learners what they need*. This view, which considers that even adult learners sometimes do not know what sort of support they need, proposes "active intervention to prevent failure and encourage student success" (18:20).

Concept 5.0: Interaction

Distance education potentially involves three types of interaction, or interactivity: (1) learner-content interaction; (2) learner-instructor interaction; and (3) learner-learner interaction (33:100-03).

Interactivity is necessary for education, including distance education, to occur, as Andrews points out:

> Learning requires interaction. The learner must accept the information provided, process it, and internalize it. Furthermore, the instructor requires feedback from the student to adjust instructional strategies, apply remediation, and respond with encouragement that is intrinsically motivating.
>
> . . .

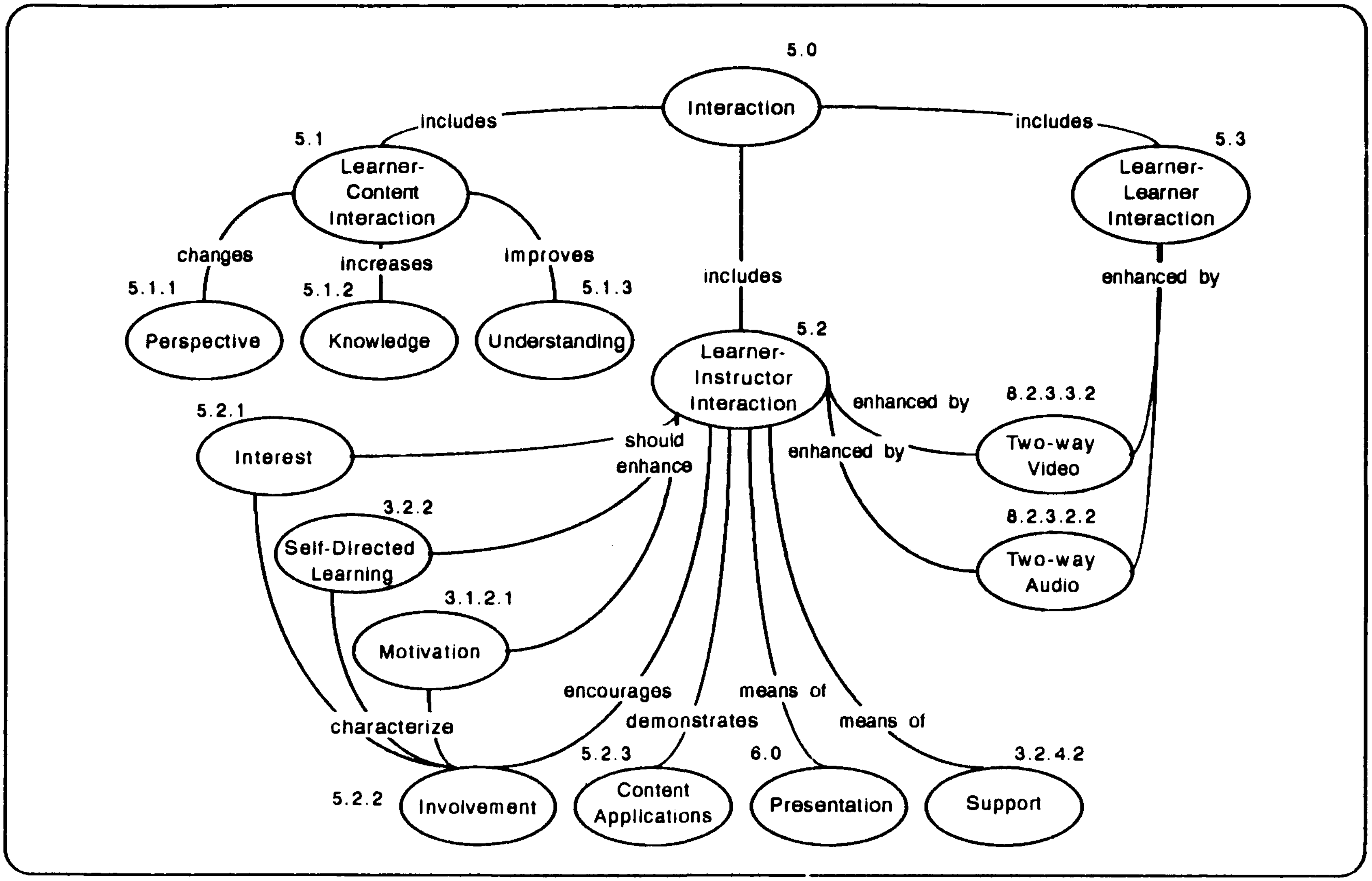

Figure 3.7. The Concept, "Interaction"

> Through various communication systems, ***students and instructors*** and *students and students* can converse. Also, students interact with the *instructional content*: sometimes the instructor is a machine. The issue is to establish standards for interactivity, guidelines for achieving it, and requisite skills for distance learning faculty with respect to interactivity. (5:11)

Concept 5.1: Learner-Content Interaction.

Moore discusses the need for distance educators to distinguish correctly between the types of interactivity. *Learner-content interaction* "is a defining characteristic of education. Without it there cannot be education, since it is the process of intellectually interacting with content that results in changes in the learner's understanding, the learner's perspective, or the cognitive structures of the learner's mind" (33:100-101). This incorporates the learner's self-interaction—the internal conversation about the ideas and information perceived in the content (33:100-101).

Concept 5.2: Learner-Instructor Interaction.

Learner-instructor interaction "is interaction between the learner and the expert who prepared the subject material, or some other expert acting as instructor" (33:101). Like learner-content interaction, this interaction represents an attempt to "achieve aims held in common with all other educators" (33:101). These objectives include:

(1) maintaining meaningful student involvement, which involves

   (a) stimulation or maintenance of student interest in the content;

   (b) student motivation to learn; and

(c) enhancement of student interest, self-motivation, and self-direction;

(2) presenting the material, including information, skill demonstrations, and attitude and value modeling;

(3) organizing learner application of the content, including organizing evaluations of learner applications; and

(4) providing counseling, encouragement, and support to learners (33:101-102).

It is the educational goal of learner application of content that most suffers from lack of learner-instructor interaction. Moore adds that without learner-instructor interaction, learners do not know enough about the subject to be sure that they are

(1) applying it correctly,

(2) applying it as intensively or extensively as possible or desirable, or

(3) aware of all the potential areas of application. It is for reality testing and feedback that interaction with an instructor is likely to be most valuable. (33:102-103)

As discussed in the following section on control, learner-instructor interaction can promote greater learner control of the educational process (18:18).

Concept 5.3: Learner-Learner Interaction.

The final major form of interaction is that which occurs between learners. This interaction may be between two or more separate learners, between combinations of single learners and groups, or between two or more groups of learners—with or without the immediate or mediated presence of an instructor or

facilitator (33:103). Learner-learner interaction can be extremely important, or even essential, for the effective learning of some concepts and skills (33:103). Moore refers to Phillips, Santoro, and Kuehn (1988), who instructed students in the principles and skills of effective committee and similar group work. Moore comments:

> the researchers found they could not effectively facilitate interaction among members of a large undergraduate class in face-to-face classrooms, and turned to distance education techniques, using recorded video and computer interaction to achieve higher performance in group behaviors than they had been able to obtain in live groups.(33:103)

Moore adds that, besides situations where interaction *is* the course content, there are other times when learner-learner interaction can be valuable. These are dependent on variables including the experience, autonomy, self-motivation, and age of the learner. He states that distance educators must structure programs that ensure the "maximum effectiveness of each type of interaction, and ensure they provide the type of interaction that is most suitable for the various teaching tasks of different subject areas, and for learners at different stages of development" (33:104).

For some courses, peer interaction is more important than learner-instructor interaction. For example, at AFIT the SYS 200 PCE course is offered as a combined lecture and group discussion/project course (13; 40). Each group consists of people of widely varying backgrounds, pay grades, and experience (11). Many SYS 200 students report the most valuable aspect of the course as the opportunity to share ideas, approaches, and experiences within such a diverse group (11). The synergy of such experiences helps people gain a broader perspective of their own jobs, others' jobs, and the overarching purpose and objectives of their mutual broader profession (acquisition management, in this

case [13]). SYS 200 is an example of a course which, although it is not a graduate course, aims to communicate not only specific information, but also to provide an environment offering opportunities for integrative thinking (11). Courses like this, in which abstraction and synergistic interaction are objectives, will benefit more from peer and learner-instructor interaction than will courses that require lower cognitive activities and independent performance (11). In the past, the objective of synergistic learning has been achieved through the small group meetings and unofficial social gatherings between the resident learners. In July of 1991, AFIT, for the first time, offered SYS 200 via satellite to several bases (13; 21). It remains to be seen whether the student groups at the remote sites perceived synergistic interaction like that reported by resident PCE students.

As noted in Chapter I, graduate educators and students may attach strong values to classroom interaction as a vital part of the collegiate environment (29; 43). While the thought of "distance education" may conjure images of isolation or academic sterility in some minds, the question remains as to whether resource-constrained graduate educational institutions, such as AFIT, can meet some of their objectives through distance education. Major Jolly T. Holden, Ph. D., of AFIT Operations and Plans, related that much distance education research indicates discomfort with the lack of traditional classroom interaction, both with the instructor and with learner peers, does not translate to weaker performance for distance learners (21). While many distance learners do express a preference for resident coursework, they typically achieve equal and higher scores than their resident counterparts, indicating that when circumstances (either the learner's or the institution's) do not allow learner and instructor comfort to be a primary consideration, distance delivery should be considered (21). Major Holden also pointed out that the distance technologies available now are much more

successful in reducing the real and perceived isolation of learners from instructors and from each other (21). For courses which do require more real time interaction, distance education technologies exist to accommodate the need (21).

Concept 6.0: Presentation (Instruction)

Presentation is communication of the instructional content, including presenting information, demonstrating skills, and modeling attitudes and values (8:30; 33:101-102). In distance education, presentation is mediated through communications media technologies (8:105). The effectiveness of presentation may be enhanced by learner progress feedback to the instructor (8:30; 30; 33:101-102).

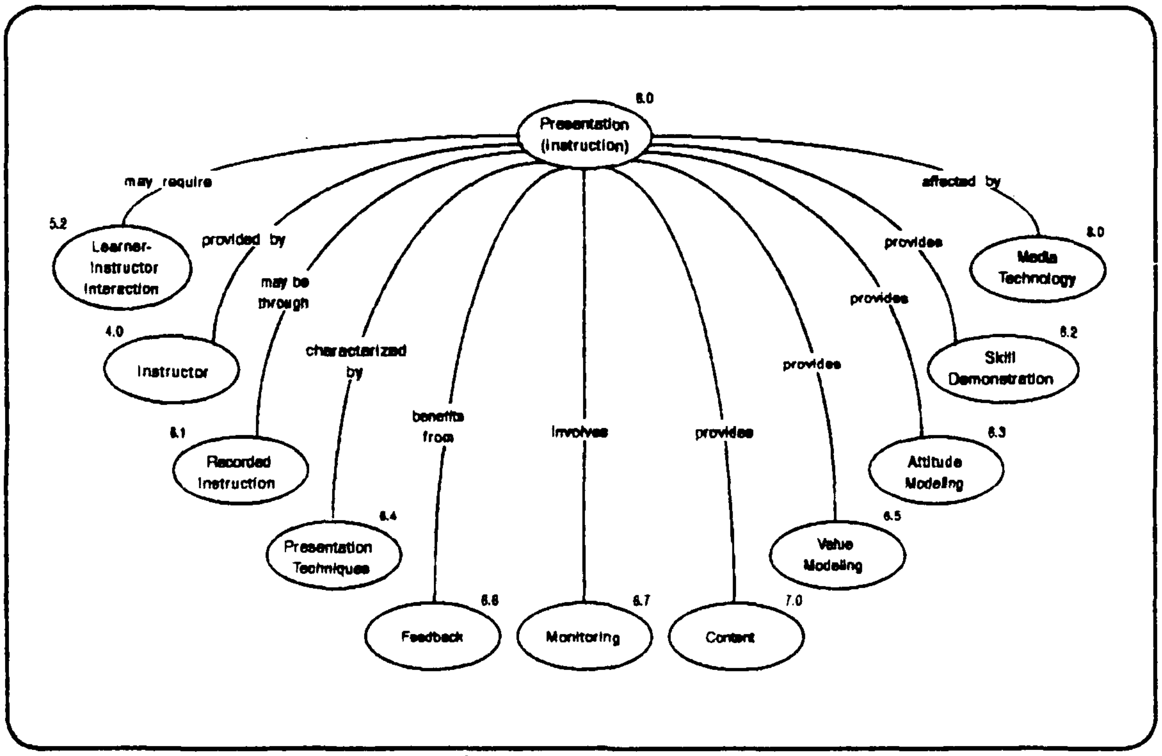

Figure 3.8 The Concept, "Presentation"

Concept 7.0: Content

The content of a course is the information, ideas, attitudes, values, and skills to be conveyed to, and received or mastered by, the learner (8:30; 33:100-01). Content is a common feature of all education (33:101). It is presented by the instructor, in learning materials, and by either or both of these through communications media (8:30). It is the learner's interaction with content that leads to learning—the construction of knowledge (5:11-13; 33:100-01; 37:7). Learner interaction with the instructor may facilitate learner application of the content (33:102-03). Some distance education researchers see the granting of greater learner control over content as a principal aim of distance education (18).

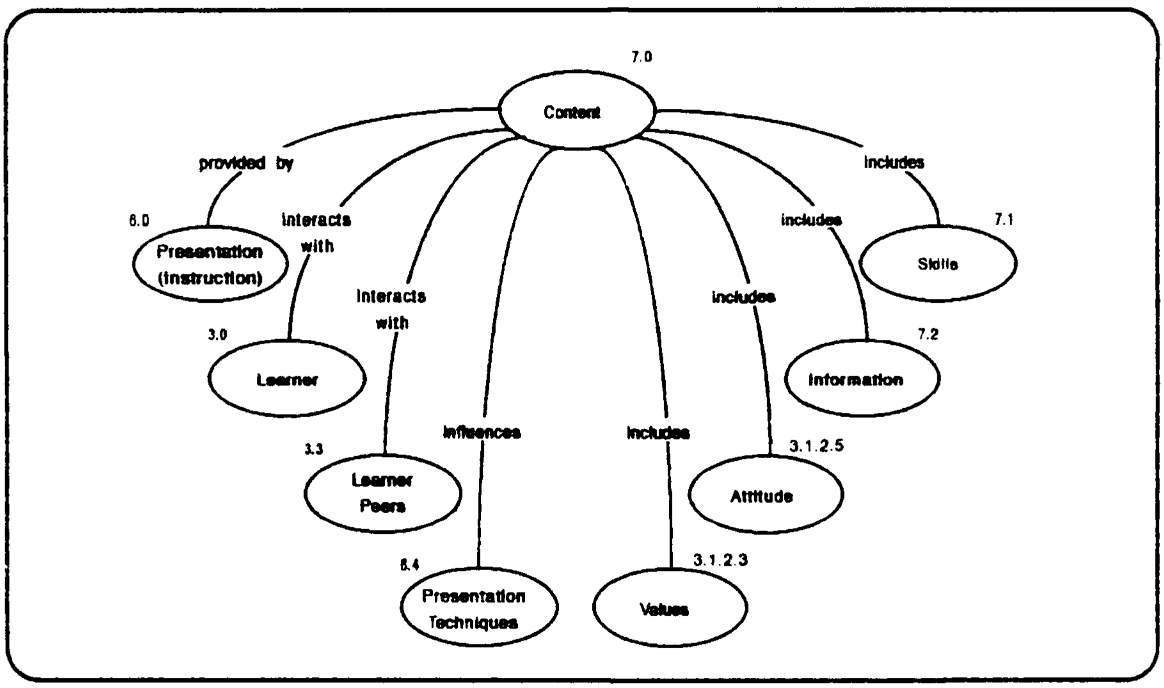

Figure 3.9 The Concept, "Content"

Concept 8.0: Media Technology

Effective distance education requires a combination of technologies (Figure 3.10) that are well matched to the appropriate instructional design and presentation methods of the candidate educational program (8:105). It is useful to distinguish among *storage media* technologies, such as audio cassettes and erasable optical disks, the *transmission media* over which distance education is conducted, such as standard telephone lines and satellite transmissions, and the specific devices and technologies that apply or employ storage and transmission media. The following discussion reflects these distinctions.

According to William Bramble, two broad categories of technology enable distance education to occur. First, there are technologies, usually involving real time educational transmissions, that reduce the perceived distance between learners and instructors and among learners (8:105). These media and other technologies occupied a primary focus of this research. Second are those technologies which "are used at the learning site to enhance learning in an off-line mode" (8:105). These might include printed material, recorded media, and computer-based instruction (disk-based instruction). While their importance in the distance educational process may be great, those technologies that do not involve learner-instructor interaction received only cursory treatment in this research. The focus is on interactive technologies.

While technology and media should not, ideally, be the determining factors in distance education design, instructional design for distance education is, in practice, typically technology-driven (27:7). Organizations usually design their distance education and distance training programs around their existing resources, rather than designing the ideal system and then seeking the

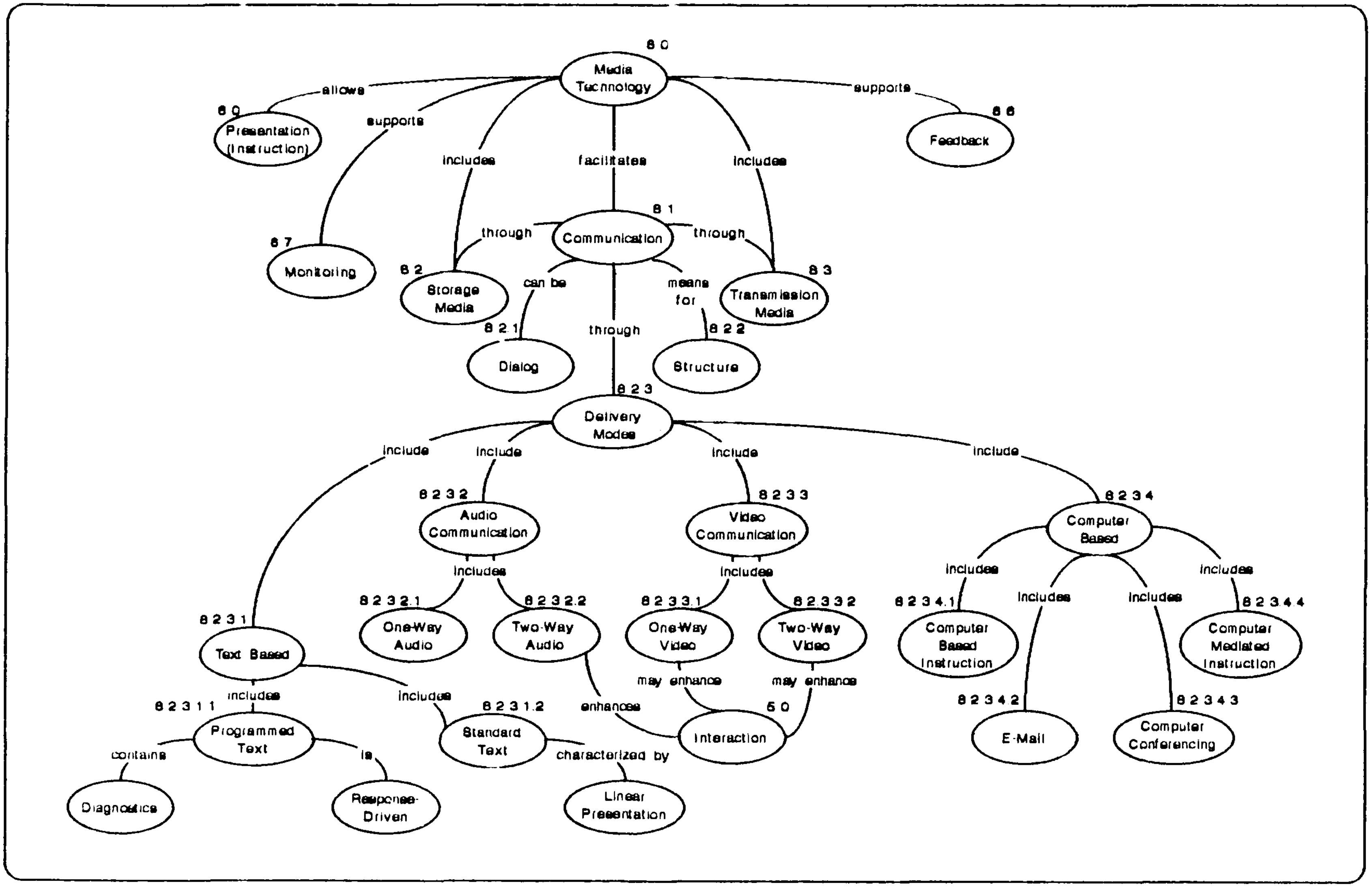

Figure 3.10 Media Technology

necessary resources to support it (13:2; 27:7). This desire to optimize the use of already owned resources is understandable from a cost-effectiveness perspective. It is also understandable in light of the significant gap between the potential of current technologies and their actual successful exploitation (27:7). Organizations may be reluctant—often with good cause—to invest in the latest and best technologies when they sense they have barely tapped the potential of the technologies they already possess. Attention is needed in reducing "the gap between technology and its application for distance education" (30:7).

Designing a distance education approach based on existing resources does offer the opportunity to optimize the use of resources. There may be cases, however, when optimizing resource management can undermine the educational objectives. It would be tempting, but potentially misleading, to determine existing resources and then design all instruction to fit within the limitations of those resources (24:40). Instructional developers must first consider the instructional functions to be addressed, then determine whether their institution's existing distance education resources are appropriate to those functions (24:40). If the resources are suited to the educational task, there is no problem. If not, the instructional designers can seek to justify and acquire additional resources or defer from offering unsuited instructional programs by distance education means (24:40).

Concept 8.1: Communication (through communication media).

According to Keller and others, several assumptions guide distance education planners and designers in selecting and adapting media to their programs. First, "Media are the backbone of communication in distance learning" (27:7).

Second, "Media can influence learning effectiveness" (27:7). Third, "Ultimately, all instructional material must be transmitted in a form that stimulates one or more of the senses" (27:7).

Communication may be described in terms of media (transmission and storage), delivery mode (text based, audio, video, or computer based), and direction (one-way or two-way). Two-way communication may be synchronous or asynchronous. *Synchronous* communication—for the purpose of distance education—refers to two-way, simultaneous communication. Examples include a normal telephone conversation, packet radio (cellular telephone), teleconferencing, and videoconferencing (33:103). *Asynchronous*, communication—for the purpose of distance education—refers to two-way, one-at-a-time communication (33:103). Examples of asynchronous two-way communication include push-to-talk desk communications sets (48:16).

Communication may provide dialog and structure in the educational process. Dialog is "communication during the instructional transaction (learning phase) and is concerned with the student's intellectual, physical, and emotional needs for learning." (18:23). Structure, in this context, is a communication variable "concerned with the flexibility of the program. It also appears to reflect the degree to which the teacher determines the objectives, content, and strategies" (34:11; 18:23).

Concept 8.2: Storage Media.

Storage media provide a means for storing data, including text, numbers, graphic images, sound resources, and executable computer instructions. ***Printed media*** (also called *text*) may contain textual information (words, numbers, and

other symbolic communications) and visual information, such as photographs (exact likenesses of real objects) and graphics (illustrations, charts, graphs, etc.).

Magnetic media record data in patterns of alternating polarization or differential degrees of magnetization upon a magnetic surface (17:159; 38). Magnetic media must be written to, and read from, by devices that can physically sense and change the magnetization of segments of the medium (38). Analog magnetic media record continuous gradations of magnetization (38). These include standard audio and video tapes (38). Digital magnetic media record discrete *bits* of data, units of positive or negative polarization that can be interpreted by computers as ones and zeros (38). These include standard computer floppy disks, fixed disks (hard disks), computer backup tape, and digital audio tape (38). Data stored on magnetic disk media are accessed directly, making magnetic disks suitable for interactive software programs (30; 38). Data stored on tape is sequentially read, or accessed, making tape media unsuitable for interactive material (38).

Optical media record information in electronically readable, microscopic pits burned into a photosensitive surface by a laser beam (9:63). Optical storage devices use a laser to read these bits of information as variations in reflected light (9:63). Optical media include CD-ROM (compact disk—read only memory) disks, which can be read, but not written to or altered by the user, and WORM (write-once, read-many) disks, which the user may write to once, but not alter thereafter (36:151; 38). From the user's perspective, optical disks may seem to be *read* sequentially, much as a standard text would be (36:152). Since CD-ROM and WORM drives access data directly, however, optical media are also used for interactive software programs (including CAI/CBI programs [19:64; 38]). The very large storage capacity of an optical disk (in excess of 700 megabytes of

data—or 300,000 pages of text [36:151]), combined with direct data access, make this technology nearly ideal for large catalogs or databases of text, images, animation, sound resources, and executable software (36:151; 38). Massive storage capacity, direct access, and relative inexpensiveness also make optical media a good choice for electronically stored educational reference (i.e., library) materials (21).

Magneto-optical media use a laser to briefly heat a sector of a narrow track on the recording surface of a plastic disk (9:63). When heated, the recording surface retains the polarity of a magnet situated on the opposite side of the disk from the laser (9:63). Erasable optical disks permit this heating and polarizing action to occur many times (9:63). Data on magneto-optical media may be directly accessed by a polarized laser (39:106). Magneto-optical media offer advantages in mass storage (removable 600 to 1000 megabyte disks), durability (the optical read-write head is farther from the medium than a magnetic head is from a magnetic surface), and data safety—the disks are impervious to magnetic fields other than those generated intentionally during recording (39:104, 106). Magneto-optical media offer the same utility for distance education as magnetic media, but with cost advantages at higher data storage levels (2 gigabytes—about 900,000 pages of text—or more [39:105]). This may suggest reference library uses for the technology*.

Concept 8.3: Transmission Media.

Transmission media carry the signals that communicate messages over distance (42:540). They include conducting media and radio transmissions.

* Data stored on magneto-optical media may be altered if not protected by software.

Conducting media "include telephone ... wires, private wires, coaxial cables, and fiber optics" (42:41) Radio transmissions media include broadcast radio, terrestrial microwave, and satellite microwave transmissions (8:31; 42:48-49).

Telephone wires are components of telephone "lines" and sometimes the terms seem to be used interchangeably. This is not technically correct, since "telephone line" represents the concept of an end-to-end connection that may include both conducting and radio transmission media, such as optical fiber, microwave radio ("microwave"), and satellite radio ("satellite", "satellite communications", or "satellite transmission" (42:42-44, 39-49). Telephone lines (and their wire and other components) can be differentiated on the basis of who deploys and controls them, by their transmission speeds and frequency ranges (bandwidths), by their physical characteristics (gauge, shielding, number of conducting wires, etc.), and by how end-to-end connections are handled (42:42-44, 47-49). In comparison to other conducting media, telephone wires boast relative inexpensiveness and ready availability, but are susceptible to "signal distortion and error" and offer comparatively low transmission rates (42:42).

When the using organization deploys and controls a telecommunications line, it is said to be "private" (42:42). Lines provided and controlled by common carriers, such as telephone companies and long-distance services, are termed "public" and are typically used for long-distance connections and when "terrain and other environmental factors prohibit the use of private wires" (42:42).

On the physical level, ordinary telephone wire consists of *twisted pairs* of single conducting wires which are bundled and sheathed (42:43). Twisting minimizes signal distortions between adjacent wire pairs (42:43). Twisted pair wire has the lowest signal transmission rates and highest error rates of the three conducting media discussed (30).

Coaxial cable is a conducting medium consisting of "one or two central data transmission wires surrounded by an insulating layer, a shielding layer, and an outer jacket" (42:537). It can carry many more signals within a given time—and with a lower error rate—than twisted pair (42:537). Coaxial cable is generally used over relatively limited areas, such as a building, cluster of buildings, or a neighborhood (30). It is often the transmission medium for local area computer networks (30).

Optical fiber lines are conducting lines "composed of glass fibers that carry information as light pulses" (8:31). Optical fiber "can carry enormous amounts of information in comparison to conventional ... wire" (8:31). Optical fiber provides private, secure transmission and can accurately transmit digital signals over very great distances (without the repeaters required by twisted pair and coaxial cable [37]).

Telephone networks handle end-to-end connections in one of two ways. Voice transmissions use voice circuits and *switched connections* (42:43). The actual circuit (path) used in a switched line cannot be guaranteed to remain unchanged over several connections between the same endpoints, limiting the quality and speed of the connection (42:43). This uncertainty of the physical path, combined with the lower speeds and transmission rates, makes switched lines suitable for voice traffic and only small amounts of data traffic—especially when "many locations must be contacted for relatively short periods of time" and when those locations regularly change (42:42-43). A traveller linking a portable computer to another site would use switched lines (42:42).

For situations requiring long connection times, high transmission speeds, and high volumes of traffic, dedicated lines may be leased from a common carrier (42:539; 14:36). In such cases, a *leased line* may prove more economical than

numerous switched connections (42:44). Leased lines maintain the same same physical route from end to end (30). An advantage of leased lines is that they can be *conditioned* to increase transmission speeds to up to 64,000 bits per second (bps), for voice traffic (faster for digital data), and to decrease error rates (42:44). High fidelity multiplexed lines incorporating wire and other media, such as optical fiber and microwave links, can be leased when very high transmission speeds are needed (42:44). The most common, and least costly, of these is the "T1" carrier, a digital line with a transmission rate of 1.54 million bits per second which can transmit voice, data, and compressed video traffic (14:38; 42:44).

Communication Modes.

Text Based Communication.

In this age of technology there is a tendency to overlook—or even look with disdain upon—the technologies of previous generations (11). Nowhere is this more true than with text based (i.e., printed words) materials (13; 21). Any approach to education, including distance education, will probably use printed material to convey some of the educational content. *Standard text* presents the content in a linear fashion. The learner reads the material from beginning to end, without any non-linear movement through the text being planned by the writers (15). Standard text is non-interactive. *Programmed text* is written in a way that allows the learner to move from topic to topic on the basis of the learner's performance in diagnostic portions of text (13; 18). This is a *prescriptive* approach, in that it seeks to determine what the learner already knows about the subject before directing the learner's further study (11). Since programmed text

responds, in a sense, to the learner's needs, it is regarded here as an interactive technology.

Audio Communication.

One-way Audio.

One-way audio communication media, such as recorded audio messages (usually on audio cassette) or standard radio broadcasts, do not satisfy the definition of interactivity used in this research. If a one-way audio delivery medium, such as broadcast radio, were used in conjunction with a separate interactive component, telephone for instance, the overall system could be considered interactive. No such system, however, was discovered in the literature reviewed. It is worth noting, however, that broadcast radio has been an effective educational vehicle in developing countries (26:1-67; 8:30).

Two-way Audio.

Two-way audio may be achieved in a number of ways, including a standard one-to-one commercial telephone call, a toll-free one-to-one telephone call, a speaker-phone or desktop communications set call, and a conference call (8:30). The ***standard commercial call*** could be initiated by a learner or by the instructor. Unless the learners can recoup their expenses, they may be less motivated to call instructors or other students when such calls would incur long-distance charges. When the learners are in the same calling zone as the instructor, as in a large metropolitan area, this complication is nullified. *Toll-free lines* (WATS lines) also

alleviate individual concerns over the expense of calls (8:30). *Speaker phones* are telephones which have, instead of or in addition to the standard handset, a multi-directional microphone and a speaker, enabling more than on person at a site to simultaneously hear and speak to the other site (8:30). A *desktop audio communications set* is conceptually similar to a speaker phone, involving a desktop microphone for each learner, and speakers (either for each learner or shared by several learners [8:30]). Desktop microphone/speaker systems usually support one-at-a-time communication only (as when using a citizens band, or CB, radio), unlike a normal telephone conversation, where both parties can simultaneously speak and hear each other (8:30).

An *audio conference* (also *audio teleconference*) "interactively links people in remote locations via ordinary telephone lines" (48:4). It consists of "two-way electronic voice communication between two or more groups, or three or more individuals, who are in separate locations" (14:31). Systems include telephone conference calls and audio bridges that tie all lines together" (48:4). Conference calls allow an instructor to conduct interactive sessions with several sites at the same time (8:30).

Video Communication.

One-way Video.

One-way video technologies "are employed to distribute a video signal from a single source (or through multiple repeaters) to one or many reception sites" (8:31). Full bandwidth television may be distributed via microwave, Instructional Television Fixed Services (ITFS), satellite, cable systems, and open-

air broadcasts (8:31). If unaugmented by two-way voice capability or computer conferencing, one-way video is non-interactive.

Two-way Video.

Two-way video provides simultaneous video transmission between two sites. The "instruction site and classroom site(s) can see ... what is going on at other sites. This allows for ... interaction that more closely approximates that in the physical classroom (8:32). Full motion (*full bandwidth*) two-way video is one of the most expensive video options, with costs increasing rapidly in proportion to the number of sites involved and the geographical spread of those sites (8:32). Two-way video may be transmitted through microwave, ITFS, satellite, and cable systems (8:32).

Unlike the more expensive full bandwidth options discussed above, *limited bandwidth* video options are not economically out of reach for many educational institutions (8:32). These technologies, which include slow scan video, the picture phone, and compressed video, provide a somewhat reduced video quality that is, nevertheless, sufficient for most educational applications (8:32). The first two technologies are examples of still image video technology, which transmits still images over standard telephone lines and permits real-time interaction (14:38). Slow scan video (slow scan TV) uses a "device that transmits and/or receives still video pictures" over standard telephone lines (8:32; 14:38; 25:8). A picture phone is a communication device in which "audio is accompanied by regularly updated single frames of video from each end of the line" (8:32). In the third technology, compressed video, each conference site transmits and receives audio and limited motion video through leased T1 lines

(as opposed to standard, switched lines [8:32; 14:38]). A standard digitized full-motion video signal might require 90 million bits per second (48:18), more than 58 times the capacity of a T1 line. Moreover, compressed video may not even use the full capacity of a T1 carrier, but only that of a sub-channel (48:18). The manner in which the T1 line is multiplexed (divided into sub-channels) affects the signal quality and proportionate cost of compressed video transmissions; quality and cost decrease as transmission speed (compressed video sub-channel capacity) decreases (48:18). Obvious quality/cost tradeoffs are involved in determining how much line capacity to obtain for compressed video transmissions. Another potentially valuable—and often readily accessible—technology in this category is facsimile (fax) transmission. A fax machine "works like a photocopier with a telephone circuit stretching between the original document and the copy that is generated" (25:61).

Computer Based /Aided Communication and Presentation.

Computer based instruction (CBI), sometimes called "computer assisted instruction" (CAI), presents the educational content in an interactive computer program, usually stored on magnetic, optical, or magneto-optical media, and which may be copied to the fixed (hard) disk of a personal computer (38). Hardiman and Williams listed three generalizations about computer based (or *computer aided*) instruction that have application to AFIT distance education. First, it is effective for adult learners (19:64). Second, it is effective because it provides the learner control, flexibility, individualization, immediate feedback, and privacy (19:64). Third, its effectiveness depends largely on the staff who prepare the material and support the student (19:64).

While the use of CBI in an off-line mode, such as disk-based tutorial programs, is well established, there is also precedence for on-line, interactive use of computers as a primary or supplementary distance delivery technology (8:33). The instructor site is connected to learner sites by "telephone lines, an audio bridge, a broad-scale computer network, or subcarriers on the television signal" (8:33). Graphics and text can be entered by, and shared among, learners and their instructor (8:33). This sort of computer use is known as a *computer conference*. "Anything that can be done on a computer can be sent over the lines. ... A common example is electronic mail (E-mail)" (48:4). Adding separate audio channels to computer conferencing is known as *"audiographics"* (8:33). Audiographics devices "include electronic tablets and boards, freeze-frame video terminals, integrated graphics systems (as part of personal computers), Fax, remote-access microfiche and slide projectors, optical graphic scanners, and voice/data terminals" (48:4).

Chapter IV

AFIT's Distance Education Resources

Chapter Overview

The proper design of curriculum for the distance delivery of an AFIT/LS graduate course requires knowledge of distance education, knowledge of the available resources, and knowledge of the curriculum design standards used within AFIT. This chapter addresses the resources available within, or accessible to, AFIT which may be applied to the distance delivery of graduate courses. Current and projected near future resources were reviewed. All information was elicited from knowledgeable personnel via personal interviews.

Discussion

Dr. Ronald Christopher, AFIT's Chief of Instructional Media, stated that AFIT possesses the resources for making professional quality videotaped instruction. AFIT owns and staffs a studio for this purpose (11). Given a means of transmitting live instruction, the studio could also be used for this purpose, although it was not designed with live instruction in mind (21).

AFIT's faculty, for the most part, are not experienced in distance delivery and will require training and practice to achieve the level of communication skills and comfort with the camera necessary for live distance delivery (21). Although this may be a big task, it has been successfully accomplished at many universities and colleges and AFIT faculty should have no unusual difficulties (21). AFIT Plans and Programs (XP) employs professional in-service trainers who

are adept in communicating presentation techniques to instructors (21). This is currently an under-used service (21).

In an interview, Captain William Torres, of AFIT's Communications and Computer Systems (SCOC) office, responded to questions about AFIT's current or near future telecommunications resources that could be applied to distance education. Captain Torres stated that AFIT contracts with KAS Cable Services to provide cable links from AFIT to Air Force Logistics Command (AFLC), located at Area A of Wright-Patterson AFB (45). The cable system supports one-way video and one-way audio from AFIT (45). Any two-way audio communication has been achieved through standard telephone connections (45). Captain Torres added there is always the potential to expand this type of service to other parts of Wright-Patterson AFB or the local community through further contractual arrangements (45). While the cable system is not suitable for long-distance delivery of courses (due to the physical properties of cable systems discussed in Chapter III), it does offer the precedent of a proven application of distance education technology at AFIT.

AFIT does not currently have a contracted agreement for regular access to satellite transponders for educational use (45). Although the commander, AFLC, does have transponder channel access for command and control purposes, that channel's function and capacity are inappropriate for distance education use (45). At one time, AFIT was investigating the possibility of contracting a long-term lease for a channel from a commercial satellite. The primary obstacle was the cost of purchasing a real time satellite uplink station—about $300,000, according to Lieutenant Colonel James Holt. For that, and other reasons, AFIT did not contract for long-term satellite service (23; 21). Other types of telecommunications over commercial carrier lines, such as limited bandwidth video, conference calls, and

computer conferencing, are available, but the contracting for leased lines would be expensive—and less useful without the satellite channel for video communication (21). There are currently no plans for audio-only (by leased telephone lines) service for distance education applications (45)*.

Major Westfall and Major Holden of AFIT/XP stated that AFIT, until very recently, had been planning the establishment of an AFIT-owned telecommunications network for distance delivery of professional continuing education (PCE) and graduate courses (21; 47). The system envisioned was to be comprehensive and include an AFIT-owned satellite channel. These plans were halted when AFIT began negotiating for satellite up- and downlinks with the National Technological University (NTU), a consortium of 39 universities and colleges in the United States (45). These negotiations, precipitated by higher level arrangements between the Air Force Directorate for Civilian Personnel (AFDPC) and NTU, marked the end of any official effort by AFIT to secure a private satellite channel (45). Instead, AFIT will be given an uplink station under a grant arranged by NTU, removing one of AFIT's major obstacles (the cost of the uplink station) to implementing distance education by satellite (21). Majors Westfall and Holden, along with Captain Torres, expect AFIT to become the fortieth member of NTU within one year (21; 45; 47).

Mr. Doug Yeager, a senior executive with NTU, visited AFIT/XP on 30 May 1991, en route to meetings at the Office of the Secretary of the Air Force and AFDPC. In two meetings attended by the author, Mr. Yeager discussed the history, member schools, and mission of NTU. NTU currently offers 770 graduate courses, primarily in engineering, computer science, and management (50). The capacity of the NTU network is growing at 25-percent annually (50).

* DSN lines are not suitable for AFIT's distance education uses (45).

Thirty-two percent of the nation's engineering faculty work in NTU member schools (50). Mr. Yeager stated NTU plans to offer AFIT the use (through a year-by-year lease) of portions of a satellite channel (of the 15 channels available on the NTU transponder, only four are currently required to serve the present needs of member schools [50]). AFIT will determine the days of the week and hours of the day when it requires use of the channel (50). Downlinks at earthstations at each participating Air Force (or other Department of Defense) installation will meet AFIT's distance education needs, supporting the complete range of satellite services, from one-way audio/video transmission of recorded courses to two-way, full motion, fully interactive audio/video transmissions with those organizations that also have up-link stations (50). NTU participating sites possess downlink (and often uplink) earthstations equipped with video recorders and other sophisticated electronics that can be monitored an controlled from NTU's headquarters in Fort Collins, Colorado (50).

Mr Yeager discussed his vision of how AFIT's affiliation with NTU could unfold. First, AFIT will have the opportunity to become an NTU member, meaning it can draw courses from and supply courses to the NTU system. Then AFIT will offer, by NTU satellite, a number of PCE courses to civilian employees at sites within the now forming Air Force Materiel Command (AFMC). Initially, these sites will consist of thirteen sites, including the five Air Logistics Centers (ALCs) in California, Oklahoma, Texas, Ohio, and Georgia (45; 50). The San Antonio ALC, at Kelly AFB, Texas, already has a downlink earthstation and is receiving NTU courses (50). These will be "turnkey sites," added Mr. Yeager. NTU will provide all equipment and training.

In the next phase of development, the Air Force would extend the satellite service to other bases, with the end objective being earthstations at most or all

Air Force installations (21). While the initial courses transmitted will be PCE offerings, graduate courses could be offered shortly thereafter, probably beginning with the program non-specific short courses currently offered during AFIT's summer short terms (21). After that, AFIT could begin offering program non-specific long courses, and finally, program specific courses (21). Once the Materiel Command / ALC systems are in place, later this year, AFIT will have the capacity to broadcast graduate courses along with the PCE courses for which the system is primarily being acquired (21).

The Materiel Command project is sponsored by Headquarters USAF to provide critically needed education to Air Force civilian science and engineering personnel. Currently, about 40 percent of the Air Force civilian science and engineering education budget is spent on per deim and other costs associated with temporary duty (TDY) travel (21). The joint venture with NTU will significantly reduce these costs by enabling many civilians to complete the required courses in their own local areas (21). The concept had already been tested at Rome and Kelly Air Force bases, which each have individual site membership agreements with NTU (21). These individual agreements cost about \$14,000 to \$16,000 each (21). By paying the corporate membership fee of approximately \$260,000, the Air Force is paving the way, not only for civilian science and engineering education, but for other Air Force organizations and installations to benefit from the technologies provided (21). Some other costs will be incurred by Air Force users of this agreement, including two-way audio channels for interactive transmissions (average \$.20 - \$.25 per minute per site through AT&T) and the cost of a downlink station. With all inherent costs taken into consideration, along with the facts that the corporate membership and uplink station are already provided, AFIT could deliver individual courses or

complete degree programs through satellite much less expensively than by residence (21). One type of degree that could be very useful throughout the Air Force would be a non-thesis masters degree in operations management, specifically tailored to rated officers on flying status (21). While such a degree would be useful to officers in other jobs as well, the time and schedule constraints of flying officers suggest distance education programs as a way for them to earn a degree with direct application to their career fields while being able to maintain rated proficiency (21).

Mr. Yeager mentioned that NTU received a DARPA grant for the AFIT uplink (by far more expensive, at approximately $300,000, than a downlink)*, which should be operational within several months. The grant also provides NTU's proprietary, state-of-the-art digital integrated receiver decoders (IRDs) for AFIT and each of NTU's 39 member schools (50). The IRDs will, among other things, compress and decompress the digital information transmitting to or from the member sites (50). By the close of 1991, the NTU system will be completely digital (50).

In addition, NTU is pursuing another grant (non-DARPA) to support tests of a computer workstation-based educational system at several sites (50). The test will provide each participating site three computer workstations, of different manufacturers, and the hardware and software to support two-way interactive coursework integrated with digital graphics, one-way video, facsimile, and other telecommunications technologies (50). In this context, the term "workstation" refers to a stand-alone microcomputer system whose hardware and software are customized for enhanced processing and storage performance in a particular application area, such as digital design engineering, structural and architectural

* Uplink rental has been the major cost in distance offerings of SYS 200 (21).

engineering, and advanced graphics (20). Workstations typically possess much greater random access memory (RAM), more highly integrated operating and applications software, and more accelerated processing speeds than standard microcomputers and provide true multiprocessing capability (20). The test will enlist graduate students (probably in engineering and computer science programs) to enroll in NTU courses specifically designed for workstation delivery (50). NTU expects the use of such systems to initially be in the engineering and computer science areas and to extend, as sophisticated microcomputers become more affordable, to other academic areas (50; 21). Even if AFIT does not elect to participate in the initial tests, the future of NTU's workstation based education will be of direct interest to the institute (21).

In summarizing his comments, Mr. Yeager responded to a question from Major Westfall about the possibility of integrating existing resources on Air Force bases. He reiterated that NTU provides turnkey systems that need no other resources to be functional. Mr. Yeager did state that the earthstations should be collocated with existing communication network hubs at participating sites, for obvious cost reasons, and that the sites should plan to incorporate the AFIT-NTU resource into their existing computer networks, so that workers, for instance, could take courses in their work areas or, eventually, on their own personal computers in their offices (50).

The preceeding discussion highlights some of the areas in which AFIT may become involved in distance education, based on existing or near future resources. While distance education may be viewed as a natural phase of organizational evolution for an institute of higher learning, it represents an expansion of activities that may be viewed by some AFIT personnel with apprehension (29). Potential or inevitable organizational changes concern many

people representing a variety of perspectives and possible mental reservations (43).

Chapter V

The AFIT Academic Instructional System and The Course Adaptation Process

Chapter Overview

This chapter contains four major sections. The first describes the curriculum design standards employed at AFIT. The Academic Instruction System (AIS) was developed jointly by AFIT faculty and the AFIT Directorate of Plans and Operations (XPO) specifically to meet the peculiar needs of educational design at the graduate level that were not adequately served by the Air Force's training model, the Instructional System Development (ISD) process (2:1).

The second section discusses the cognitive activities involved in learning, the complexity of learning objectives, and the relation of these factors to the degree of interaction required of a learning topic or task in a distance education session.

The third section presents a methodology for adapting a course for delivery by distance education technologies. The methodology is a structured decision sequence leading to technology solutions for each learning topic or task and for each instructional session (composed of multiple topics and tasks).

The fourth section is a demonstration applying the media selection process to a graduate course from the AFIT School of Systems and Logistics (LS) curriculum.

Discussion

The AIS

An AFIT AIS familiarization pamphlet begins by explaining the need for, and purpose of the AIS:

> Typically, training is targeted on the acquisition and mastery of a set of relatively concrete and specific procedures, skills, or techniques. By contrast, education focuses on the learning of concepts and ideas, emphasizing the understanding, comprehension, analysis, and application of this knowledge.
>
> ...
>
> The education process promotes the assimilation of systematized knowledge and, in that assimilation, develops one's mental faculties and improves one's judgment, evaluative and analytical abilities, and breadth of understanding. It develops the ability to think, judge, and act in functional ways when confronted with new and unique requirements in novel contexts. (2:1)

The first step of the AIS system is the identification of educational requirements pertinent to the AFIT mission. These requirements address the needs of organizations within the DOD for both PCE and advanced academic degree courses and programs (2:4). Requirements are usually identified by DOD agencies. AFIT staff and faculty also identify requirements based on trends or developments within particular academic areas. AFIT "may identify to AF policymakers a shortage or impending shortage of qualified personnel within specific academic areas" (2:4). The primary focus of distance education applications within LS has been, and will continue for several years to be, PCE courses in the fields of acquisitions and logistics. This research focuses on potential applications of distance education methods and technologies to graduate degree program courses. The graduate mission of LS is "to develop and

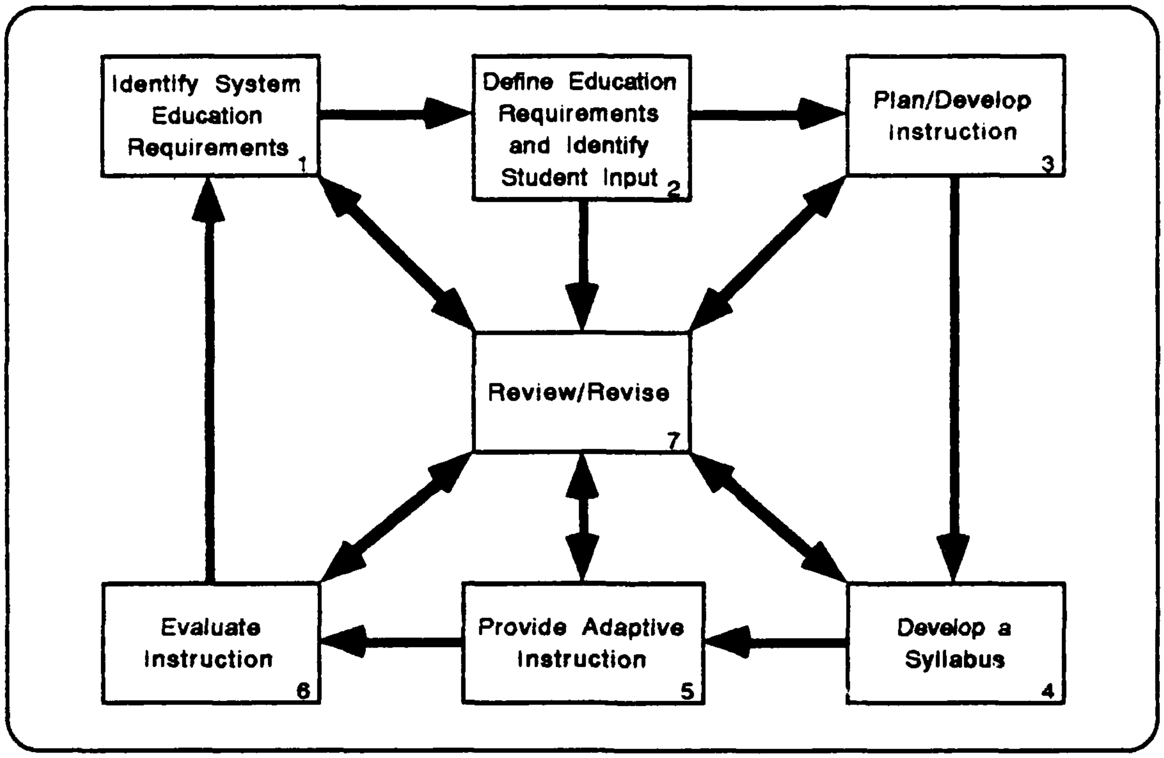

Figure 5.1 The AIS Model (2:3)

administer fully-accredited graduate degree programs designed to provide selected qualified students with the opportunity to acquire and apply to the management of complex systems a variety of analytic, quantitative, behavioral, and decision-making concepts and techniques" (1:2). Applying distance education to this mission will require identification of those courses that lend themselves to delivery through distance media. Thus, the need to present a course through distance means, indicated mainly by desired throughput of students, and the amenability of a course's material to distance delivery should be considerations during the requirements identification step.

The second step, defining education requirements and identifying student qualifications, serves to refine the results of Step 1. AFIT academic specialists and

the agencies generating general educational requirements may both be involved in defining specific requirements. AFIT's degree program courses must satisfy dual sets of requirements. First are requirements specific to the military agencies and programs served by AFIT students. Next are the requirements that establish and maintain AFIT's credentials within the overall academic community—credentials having to do with accreditation of AFIT programs and recognition of AFIT graduates' credentials by other institutions (2:5).

AFIT planners must also know the "prior education and experience levels of the students" in order to provide effective educational programs (2:5; 13). In relation to distance education, planners must determine what qualifications a student must have before enrolling in a distance course and what the student will be qualified for after completing a distance course. Representatives of LS and XPO suggested the first courses to be offered by distance education should be those that are common requirements across several graduate programs, such as summer short term preparatory courses in general mathematics, communication, and computer concepts, and other general courses offered during regular terms, such as those in statistics, management science, communication, economics, organizational science, general management, and general computer applications (29; 21).

Successful completion of Step 3, planning and development of instruction, requires the efforts of faculty possessing both the instructional planning experience and appropriate academic backgrounds for the courses being designed (2:6). This step may be applied at several levels of breadth, from a course segment, to a complete course, to an academic program of courses (2:6). The output of Step 3 is a preliminary plan of instruction (2:6).

Once the preliminary plan is approved by the appropriate department head, faculty develop a syllabus (Step 4) containing "the course description, topic listings, objectives, textbook, required references, and a statement about student expectations" (2:7). The syllabus outlines course content and is a means of sharing the course's nature among students, faculty and staff, and other organizations (2:7). Each LS syllabus is reviewed and approved through the LS faculty and administrative structure (2:7).

The fifth step, providing adaptive instruction, is potentially one of the most important for distance courses. The AIS recognizes the need for instructors to have flexibility in adapting an approved syllabus to the particular needs of individuals and groups of students (2:8). It also respects faculty professionalism and qualifications in adapting the courses (2:8). Meeting peculiar or specialized needs is one of the strong points of distance education. Flexible course design must take into account the entry knowledge of the students and the subsequent uses by the students of knowledge to be gained in the course (2:8). Instructors must ensure that evaluation instruments are also adapted to appropriately reflect any changes made in adapting the instructional plan (2:8).

Evaluation of the instruction is accomplished in Step 6. Student performance evaluations, such as content examinations and quizzes, term papers, projects, laboratory exercises, automated exercises and simulations, theses, and dissertations may also indicate something about the effectiveness of the instructional system (2:9). Student critiques of "presentation methods, course design, text book, assigned readings, course expectations, course syllabus and base facilities" are also useful (2:9). Surveying former students and their supervisors is another means of evaluating course effectiveness (2:9). Once

evaluation data are collected, they are provided to the instructor, department head, and the dean of the respective school (2:9).

Results of evaluations, including an annual evaluation report for each course, are compiled in a database used in Step 7, the review and revision step (2:9-10). The "faculty governance and administrative structure" and representatives who were involved in general requirements identification (Step 1) and in defining specific education requirements and identifying student qualifications (Step 2) use the evaluation database to conduct formal review of courses and programs (2:10). Members of accreditation agencies also periodically review academic programs (2:10).

Review and revision are not one-time activities, but are repeated with each presentation of a course and at other times deemed necessary during the instructional development process. Actual instruction often illuminates needs not anticipated during Steps 1 and 2 (2:10). The AIS is intended to allow for appropriate changes whenever they may become needed.

Cognitive Activities and Learning Objectives.

This section discusses the cognitive activities involved in learning, the complexity of learning objectives, and the relation of these factors to the degree of interaction required of a learning topic or task in a distance education session.

Cognitive Activities.

Cognitive activities are those mental faculties or processes, such as perception, intuition, and reasoning, through which people acquire knowledge

(Morris:259). Many philosophers and educators have attempted to classify the cognitive processes involved in learning. One of the most well-received classification systems, generally known as "Bloom's Taxonomy," was originated by Benjamin S. Bloom, J. Thomas Hastings, and George F. Madaus (7:271-273). Bloom's system (Figure 5.2) is a hierarchy of cognitive categories, with activities involving simple information processing on the lower (i.e., lower numbered) end. and processes involving original thought on the higher end.

Categories of Cognitive Activities

1.00 Knowledge
1.20 Knowledge of Ways and Means of Dealing with Specifics
1.30 Knowledge of Universals and Abstractions in a Field
2.00 Comprehension
3.00 Application
4.00 Analysis
5.00 Synthesis
6.00 Evaluation

Figure 5.2 Bloom's Classification of Cognitive Categories (7:271-273).

Most of the activities taking place in formal educational programs fall within Bloom's first category, focusing on the memorization and recall of specifics (facts, terminology, events, etc.) and on ways of dealing with specifics, such as conventions, trends and sequences, classifications and categories, criteria, and methodologies (44:169). The highest sub-level within the first category (level 1.30) is that having to do with the learning of "principles and generalizations"

and the somewhat higher "theories and structures" (7:271-273). Although graduate education will necessarily involve cognitive activities below the level of analysis (level 3.00), graduate work should focus on the upper levels of application, analysis, synthesis, and evaluation (21; 13).

Cognitive Activity Levels, Task Complexity, and Interaction.

It is helpful to determine if interaction is required to achieve the learning objective. The operational definition of interaction presented in chapter one defined interaction as reciprocal action or communication between a learner and a source of instruction (instructional material or instructor), between learners and instructors, or among learners* (46:955; 33:100-101). A premise synthesized from literature and interviews is that the higher the cognitive level of activity required to accomplish an objective, the more likely that the learner will need some form of interaction. Specifically, ***application*** and higher cognitive activities benefit from learner-instructor interaction (33:102-03). The student may require interaction with the instructor. This can be provided during class (on-line) or through an off-line mode, such as telephone office hours or electronic mail. If interaction during class is required, a two-way communications medium is needed. In general, as the cognitive activity level increases, so does the complexity of the task (24:39). It is feasible, however, for different levels of complexity to exist within each cognitive activity level. This may have to do with the initial knowledge required of the learner (32:iii). For example, if the objective involves understanding and recalling definitions of terms, and the learner possesses a knowledge background

* Interaction with the content is assumed to apply in any situation, regardless of the cognitive activity level.

of familiarity with all the components of each term's definition, the learning task is simple. If, however, the learner is unfamiliar with the component concepts in the definition, the learning task is complex—the learner must first become familiar with the background information which will make understanding the new term possible. This is so because the "construction of new knowledge begins with our observations of events or objects through the concepts we already possess" (37:4).

Learning Objectives.

One reason instruction and evaluation tend to focus on the lower, or informational, cognitive activity levels is that such material is easier to organize, present, and test (44:169). Instructional planning systems that call for very explicitly defined learning objectives can lead to a focus at the lower cognitive levels, as Tanner and Tanner related:

> The more explicitly defined the objective, the more likely it is to be confined to the lower cognitive process of simple recall. Yet ultraspecificity in objectives is called for in guides to writing objectives. (44:337)

These authors warned that ultraspecific objectives can lead to a disintegrative curriculum that "is not likely to help the student develop an integrated outlook or philosophy or lead to transfer of learning" (44:337). Ultraspecific objectives are more appropriate to training than to education (2:1; 18). The goal in designing graduate distance learning objectives, then, should not be ultraspecific objectives, but the development of general objectives addressed by more specific topics and tasks. When very specific topics and tasks are employed, the instructional

designer must take care to integrate the learning tasks into the overall goals of the course. The statement of learning objectives should illuminate the main considerations which determine appropriate media of delivery to the remote learner—such considerations as the cognitive activity required of the learner and the types of interaction (learner-instructor, learner-learner, and learner-content) required to achieve the objective.

The Course Adaptation Process.

Overview.

This section presents an eight step methodology for adapting a course for delivery by distance education technologies. It discusses the structured process (Figure 5.3) proposed for adapting a resident LS course for distance delivery. The process assumes as input an existing graduate course with identified learning objectives (represented by distinct instructional topics and tasks) and established methods of presentation. The adaptation process applies a structured approach, involving several steps, and provides a course distance delivery plan identifying

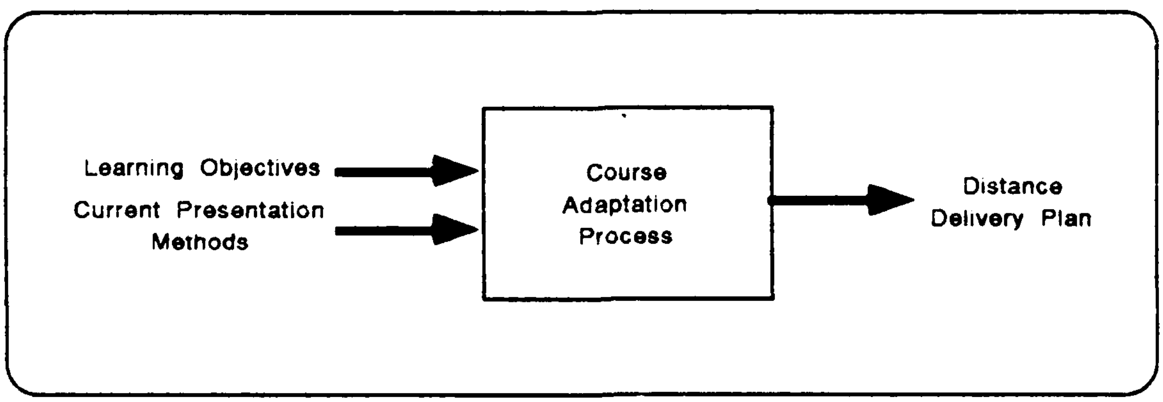

Figure 5.3 The Course Adaptation Process

the delivery technology and pertinent comments for each instructional topic, task, and session (group of topics and tasks presented as a unit).

Steps in The Course Adaptation Process.

The process for adapting a course for distance delivery involves eight steps (Figure 5.4). Each step is discussed in detail below, following a brief overview of the entire sequence of steps.

1. List and Number Learning Objectives.
2. List Current Presentation Methods.
3. Determine the Cognitive Activity Level and Complexity of Each Topic/Task.
4. Apply the Media Selection Tool to Each Objective.
5. Record Media Selection Results.
6. Group Objectives into Sessions.
7. Identify Delivery Technology for Each Session.
8. Record Pertinent Comments.

Figure 5.4 Steps in the Course Adaptation Process

A topic/task analysis worksheet (Figure 5.5) aids the course designer in recording the learning objectives*, current presentation methods, cognitive activity levels, topic or task complexity, and the solutions provided by the media selection tool. After entering the course information at the top of the worksheet,

* Note that the objectives and their degree of detail, or specificity, are determined by the course designer prior to considering distance delivery technologies.

Topic/Task Analysis Worksheet

Course Number: ______________________ Date: ___/___/____

Course Title: ______________________ Page ___ of ___

OBJ. NUM	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES

Figure 5.5 Topic/Task Analysis Worksheet

the course designer lists and numbers the learning objectives (topics and tasks) in the first two columns of the worksheet, and enters a description of the current (i.e, resident) presentation method in the fifth column of the worksheet. This should be completed for all distinct learning objectives before proceeding to subsequent steps.

Next, steps three through five must be completed for each learning objective. Step three, filling in the cognitive activity level and complexity of each learning objective, records these two elements of information for use in step four (specifically, for answering the first two questions of the media selection tool [Figure 5.7]) Step four brings the designer to the media selection tool (Figures 5.7 through 5.12), which leads the designer through a sequence of structured questions and results to determine the minimal (least complex) delivery technology that will adequately present the material associated with the learning topic or task. In step five, the final step in completing the worksheet, the course designer records the minimal appropriate delivery technology for each learning objective on the worksheet (Figure 5.5).

Steps six through eight pertain to instructional sessions rather than to individual learning topics and tasks. In step six, the designer clusters instructionally compatible learning objectives into groups that will be presented as units, i.e., as individual sessions comparable to resident class sessions. The designer should apply consistent logic (discussed below) in clustering objectives for presentation. Step seven requires the designer to determine a single delivery technology, or package of combined technologies, for presenting each session. In step eight, the designer records any comments of potential importance to the design of the course that may not be evident from the previous steps.

Explanation of the Steps.

Preparatory Steps.

The topic/ task analysis worksheet (Figure 5.5) facilitates completion of the first five steps. The first three steps may be considered preparatory to the application of the media selection tool. First*, the instructional designer lists the learning topics and tasks for each objective in column two of the worksheet and enters the number** of the objective in column one.

Second, the designer lists the current method of presentation for each task in the fifth column of the worksheet. For example, methods could include text, lecture, graphics, instructional film, field trip, laboratory, group project, discussion, debate, etc. It is important that the terminology used to describe the current method indicate the communication modes (text, audio, audio-video, computer based, etc.) employed to achieve the instructional objective.

Third, the designer uses the interaction analysis aid (Figure 5.6) to help determine the cognitive activity level and complexity of each topic or task. He or she lists the highest cognitive activity level involved in each task in column three, and whether the topic or task is complex in column four of the worksheet.

The major consideration in answering the question of *topic or task complexity* is an estimate of the learner's base of knowledge and skills at the

---

* Entry of the course name and other information at the top of the worksheet, while necessary, is not treated here as a step in the process.

** The numbering of the objectives may be arbitrary, but it is recommended that the sequence of objectives, and their matching topics and tasks, reflect the actual sequence in which they are presented in the resident course. Since there tends to be an instructional logic inherent in the sequencing of topics and tasks in the resident course, reflecting this logic will aid the designer later in grouping the objectives into instructional sessions.

Task Description	Cognitive Activity Level of Task	Complexity of Material or Tasks	Interaction Required
Recall information: facts	1.00 1.10	LOW	NO
terminology definitions acts or events	1.11 1.11 1.12	HIGH	YES
Recognize information: facts	1.00 1.10	LOW	NO
terminology definitions acts or events	1.11 1.11 1.12	HIGH	YES
Recall or recognize Ways and Means of Dealing with Information: conventions trends/sequences	1.20 1.21 1.22	LOW	NO
classifications or categorizations criteria methodologies	1.23 1.24 1.25	HIGH	YES
Recall or recognize Universals or Abstractions in a Field: principles	1.30 1.31	LOW	NO
generalizations theories and structures	1.31 1.32	HIGH	YES
Comprehension of Information: translation	2.00 2.10	LOW	NO
interpretation extrapolation	2.20 2.30	HIGH	YES
Application	3.00		YES
Analysis: of elements of a system of relationships among elements of organizing principles	4.00 4.10 4.20 4.30		YES
Synthesis: produce a unique communication propose a plan or set of operations derive a set of abstract relations	5.00 5.10 5.20 5.30		YES
Evaluation: judgments based on internal evidence judgments based on external evidence	6.00 6.10 6.20		YES

Figure 5.6 Interaction Analysis Aid

beginning of the learning task. In estimating perceived task complexity the designer may consider:

1. previous coursework completed by the learner that could provide an applicable base of knowledge;
2. the learner's aptitude scores on required pre-admission tests, such as the Graduate Record Examination or Graduate Management Aptitude Test; and
3. the results of an initial knowledge/skills test constructed specifically for the course.

Media Selection Steps.

In the fourth step of the course adaptation process, the designer applies the media selection tool (Figures 5.7 through 5.12) to determine the minimal (least complex) distance education technologies appropriate for each learning topic or task. This may be the most time-consuming step in the adaptation process.

In reference to delivery technologies, "complexity" refers to the number of perceptual senses addressed and to the nature and degree of interaction provided. Following this thinking, a technology providing both visual and auditory messages is more complex than a medium providing only auditory messages, and two-way, real time interaction with an instructor is more complex than viewing an instructor on a video tape.

Interaction, and hence media complexity, also have to do with the linearity of the material (13; 18). A standard text, an audiotape, and a videotape

are examples of linear learning material which progress from topic to topic in a direct fashion, without diagnosing learner knowledge or skills (which would be necessary for prescribing topics or tasks). Non-linear presentation includes programmed texts, interactive software, and live instruction with two-way communications. In non-linear presentation, the sequencing of learning material and the depth of coverage depend on the learner's responses to the material. This involves diagnosis of the learner's progress and prescription of learning tasks. Diagnosis and prescription can be built in to programmed texts and interactive software (19:64).

The increasing levels of technology complexity are:

1. standard, or linear, text (including graphics interspersed within a printed text);
2. audiotape or live one-way audio;
3. programmed, or non-linear, text (including graphics interspersed within the printed text);
4. videotape or live one-way audio/video;
5. two-way audio communications;
6. audiographics;
7. interactive software;
8. live one-way video with two-way audio; and
9. live two-way video with two-way audio.

AFIT currently possesses the means to provide all the above levels of media complexity except live two-way video* .

* AFIT possesses the expertise and technology necessary for creating interactive educational software. AFIT does not, however, have an office with this responsibility.

Determining which medium is best suited for the delivery of a given learning objective should be a *structured decision process*. Such a process requires the instructional designer to work through a sequence of questions and intermediate results to arrive at a solution. The media selection approach is a series of decision flow frames comprising an algorithm, or "sequence of operations that, through a clear route and a definite termination rule, derives the final decision" (3:42). The solutions provided by use of the algorithm pertain to the atomic level of a course, that is, to individual learning objectives (tasks or topics) identified by the course designer. Each solution, or "decision," represents the least complex distance education technology that could be used to deliver the educational material for a particular learning objective.

Careful sequencing of the questions in the media selection process leads to a workable solution. *Solution results* identify the minimal appropriate medium for distance delivery. Solution results are indicated by a small stop sign. *Intermediate results* prompt another question.

The sequence of decisions in the media selection process could begin at any of several points, but for the purpose of efficiency and consistency, it begins with a question that can rapidly reduce the number of possible outcomes. A question with this capacity concerns a primary design consideration. The primary considerations used in this process are:

1. The cognitive activity level required for learner success with the learning objective;
2. The nature of the learning material in terms of
   (a) complexity, as perceived by the learner;
   (b) use of, or need for, still or motion graphics; and

(c) sequence of presentation (linear or non-linear); and

3. The degree and type(s) of interaction required for delivery of the learning material.

The researcher selected interaction as the basis for the first decision points (Q1 and Q2 of Figure 5.7) in the media selection process. Considerations 1 and 2(a), above, the cognitive activity level and complexity of the learning task, help determine whether interaction is required. Topics or tasks that do not require real time human interaction lend themselves to delivery by non-interactive (informative) media, such as standard (i.e., linear) text, audio cassette, or video tape, or by interactive media, such as programmed text or interactive software.

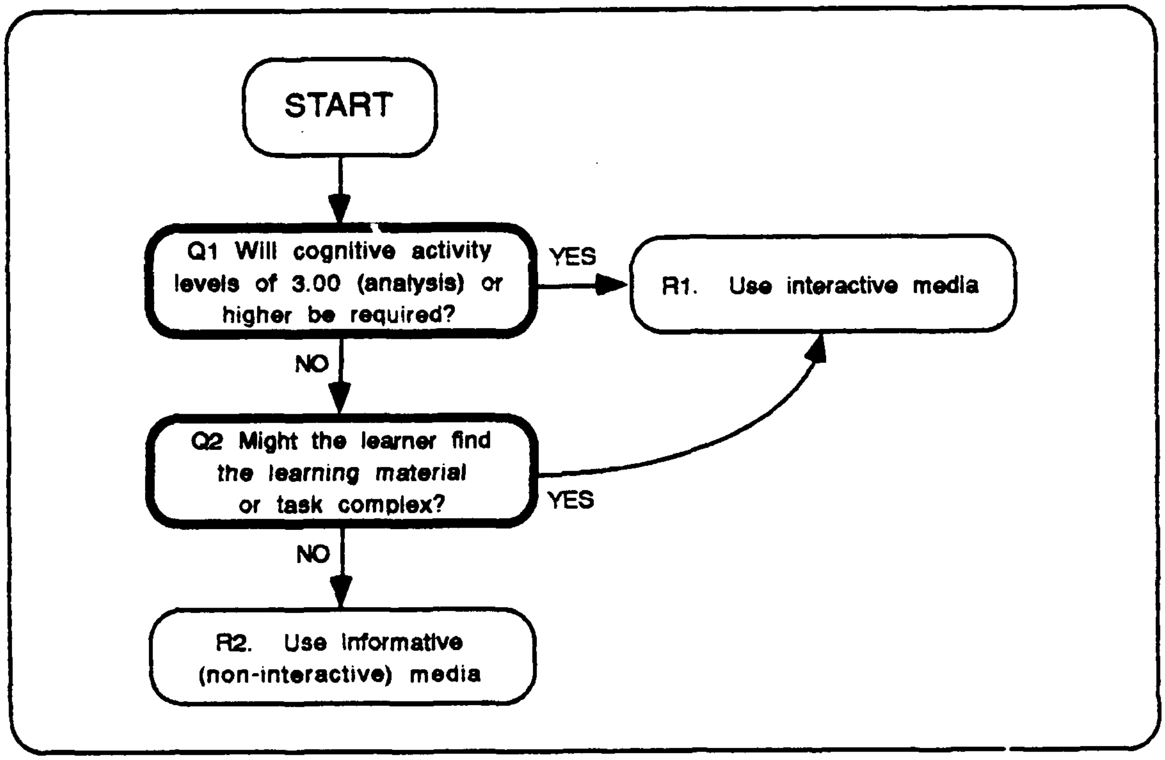

Figure 5.7 First Decision Sequence

The first decision-result sequence is represented by Figure 5.7. It asks if the cognitive activity level of the learning objective in question is either complex or otherwise a candidate for interactive delivery. Referring to columns three and four of the worksheet, the course designer answers questions Q1 and Q2 of Figure 5.7*. A finding that informative (i.e, linear) media, such as standard text or audio cassette, should be used allows the designer to skip over most of the other questions in the media selection decision frames (Figures 5.7 through 5.12).

Figure 5.8, the second frame in the media selection process, is reached by a "Yes" answer to Q1 (Figure 5.7). It begins with result R1 and probes for more decisions to further narrow the field of suitable interactive delivery media. Each subsequent figure continues this alternative-reducing process until a solution is reached.

Figure 5.9 addresses the issue of whether learner-learner interaction is required (nodes R1.1.1.1 and R1.1.i.2). It also requests decisions about the combinations of audio and visual media used.

Figure 5.10 deals with the nature of the audio-visual materials and tasks used during the session. Live images are transmissions of events occurring as the viewer watches. These require video technologies**. The presence of motion is another criterion for distinguishing among visual materials. While still images may be transmitted through video technologies, moving images *must* be.

* The designer previously (step 3) matched the learning objective to one or more of the task descriptions on the interaction analysis aid (Figure 5.6) and determined the ***highest cognitive activity level*** and the ***complexity*** of the objective.

** Video technologies also include recorded media, such as video cassettes and video discs. These, of course, are not suitable for livr transmissions.

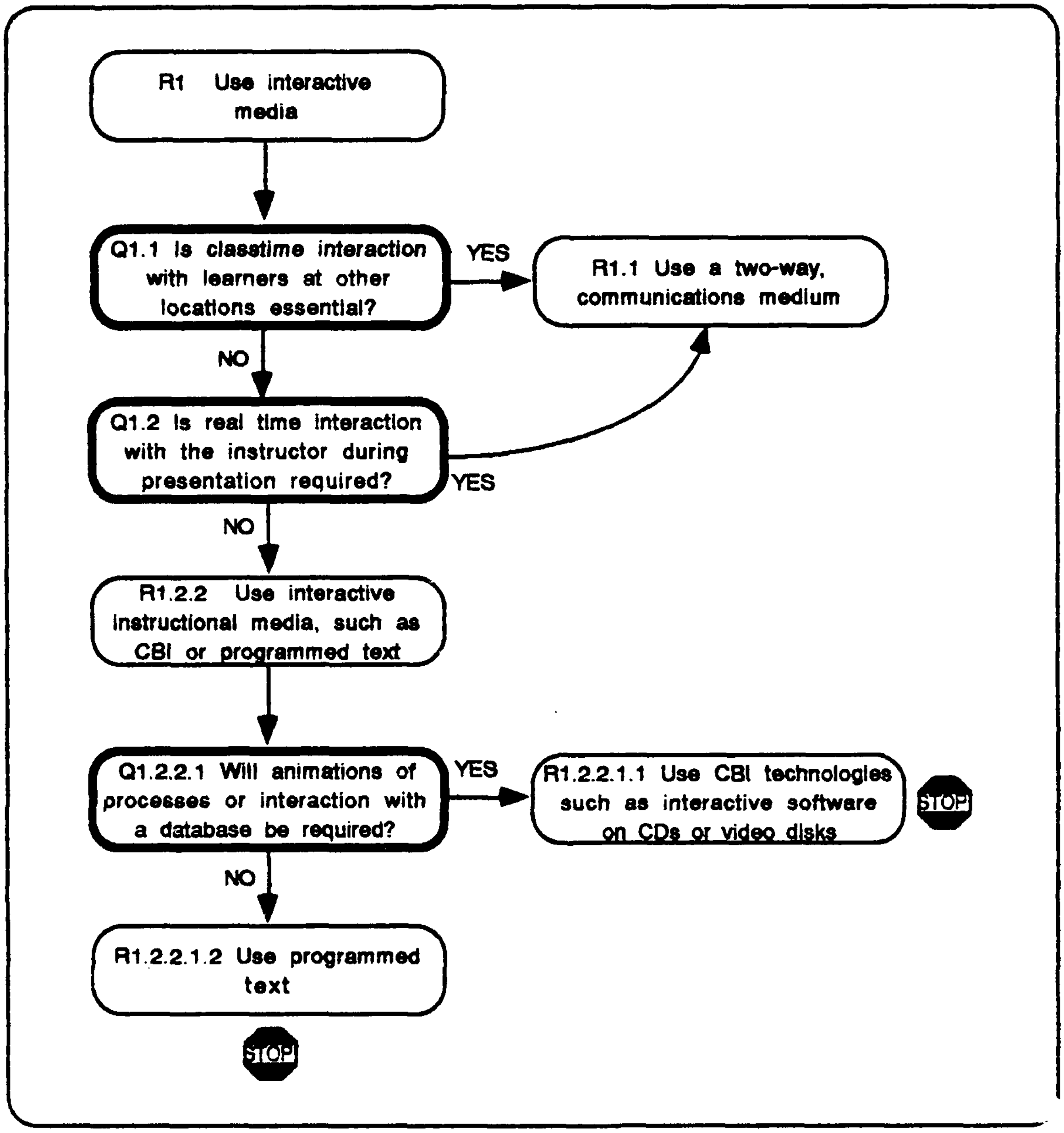

Figure 5.8 Interactive Media Decision Sequence

If images are to be altered during the session, the designer needs to determine whether more than one site will have simultaneous update access to the graphics (as opposed to only one of the sites—usually the instructor's—having update access). Shared simultaneous graphics update access requires a

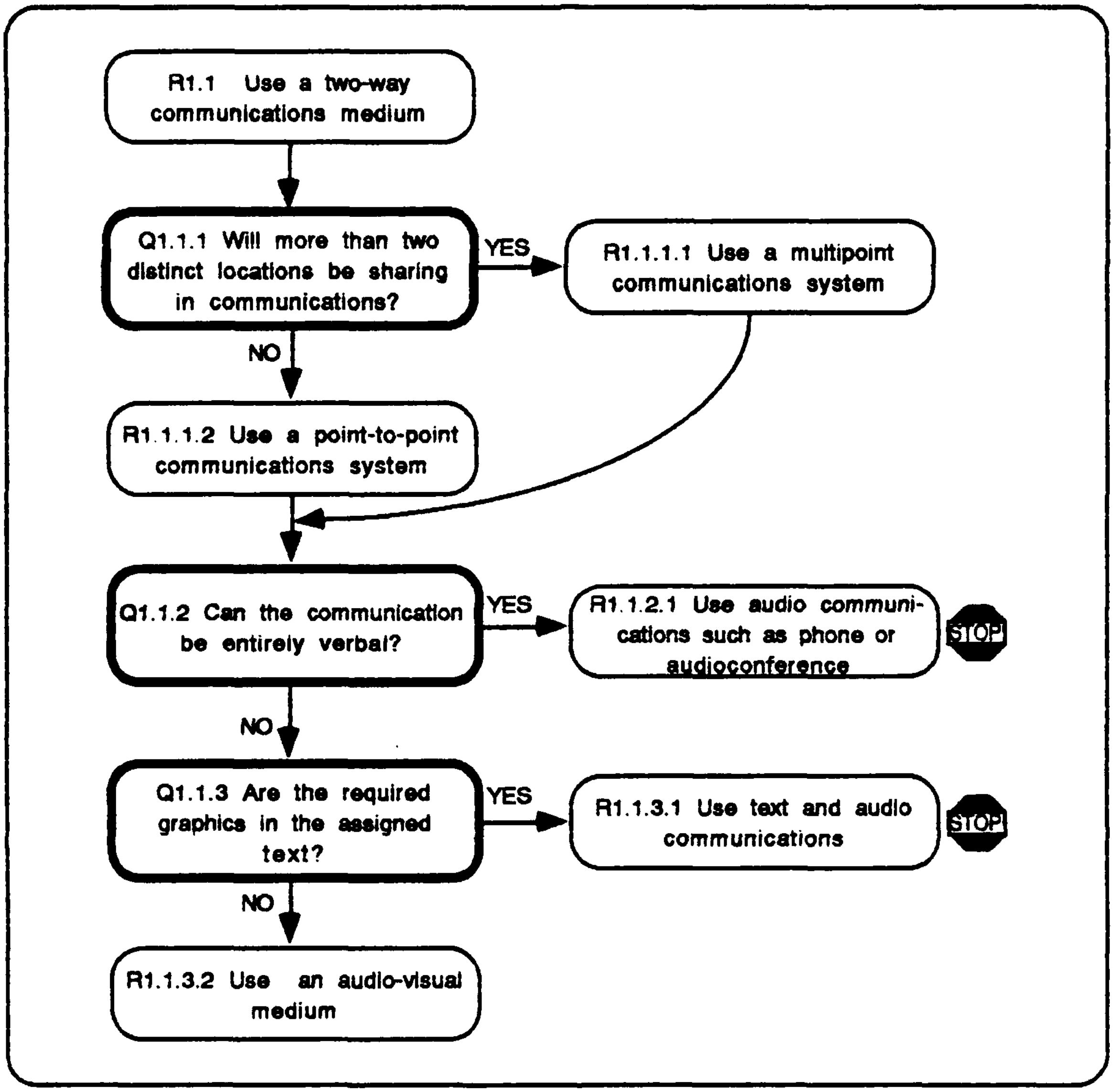

Figure 5.9 Two-way Communications Decision Sequence

shared graphics environment, which can be provided by audiographics devices and software, such as electronic blackboards, electronic tablets, and graphically supported computer conferencing. If shared simultaneous update access is not needed, less sophisticated audiographics solutions may be employed, such as

still image or compressed video transmissions or scanners and facsimile machines*.

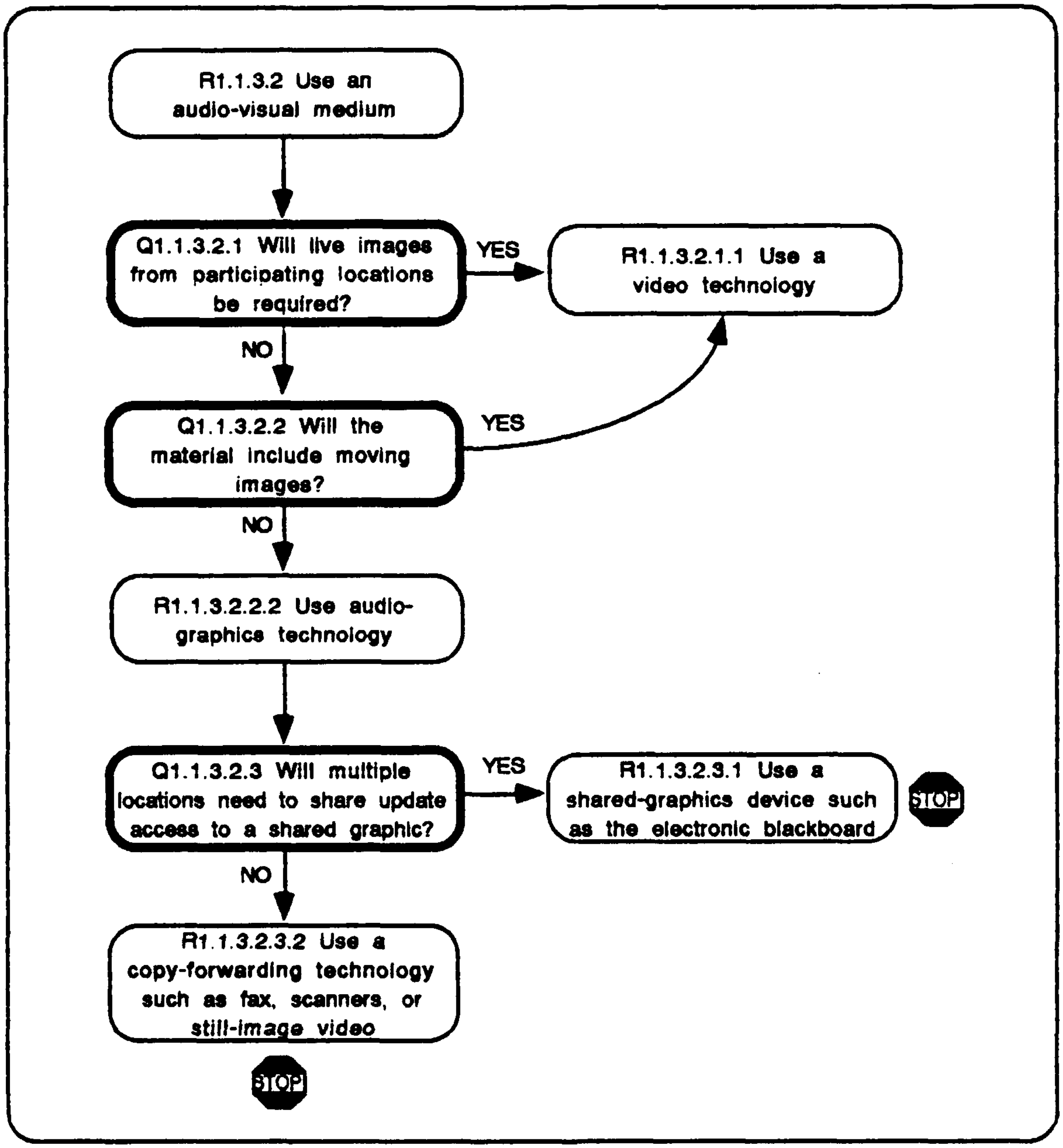

Figure 5.10 Audio-visual Decision Sequence

* It is the combination of audio transmission with these technologies that makes them "audiographic".

Figure 5.11, the video technology decision sequence, distinguishes between high- and low-quality motion requirements. Full-motion video (providing at least 30 frames per second) can be provided by satellite video and other television transmissions. When such high-quality motion is not essential, technologies transmitting fewer frames per second, via telephone lines, are feasible.

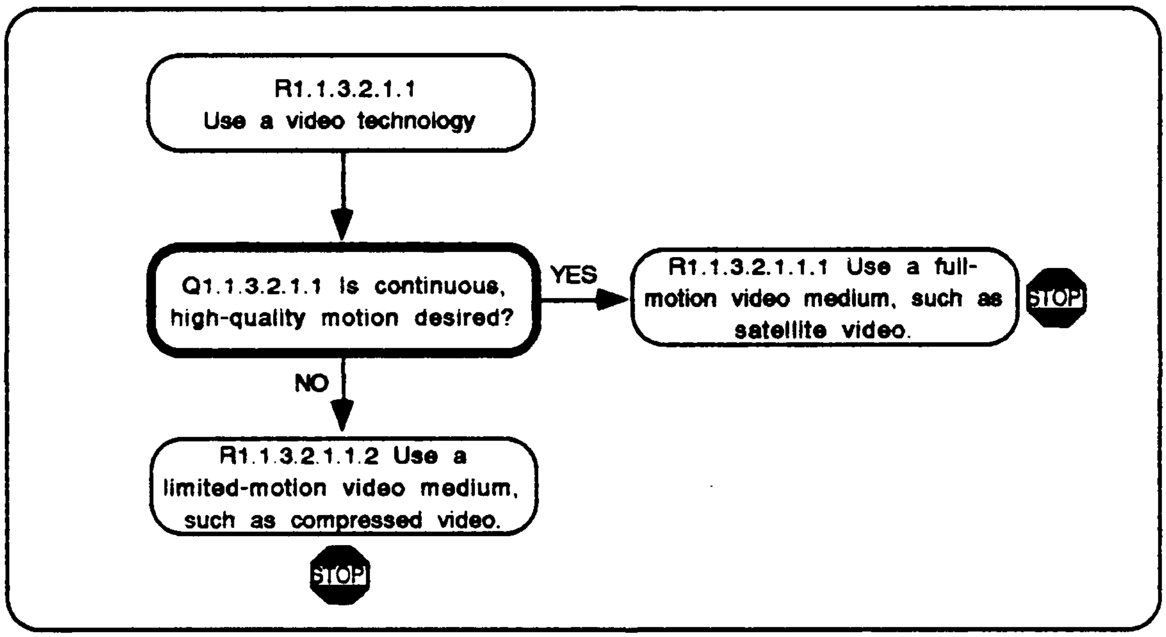

Figure 5.11 Video Technology Decision Sequence

Figure 5.12 represents the second of two primary decision forks in the media selection process. It follows directly from the first decision sequence frame (Figure 5.7). It deals with media that do not support live interaction between persons.

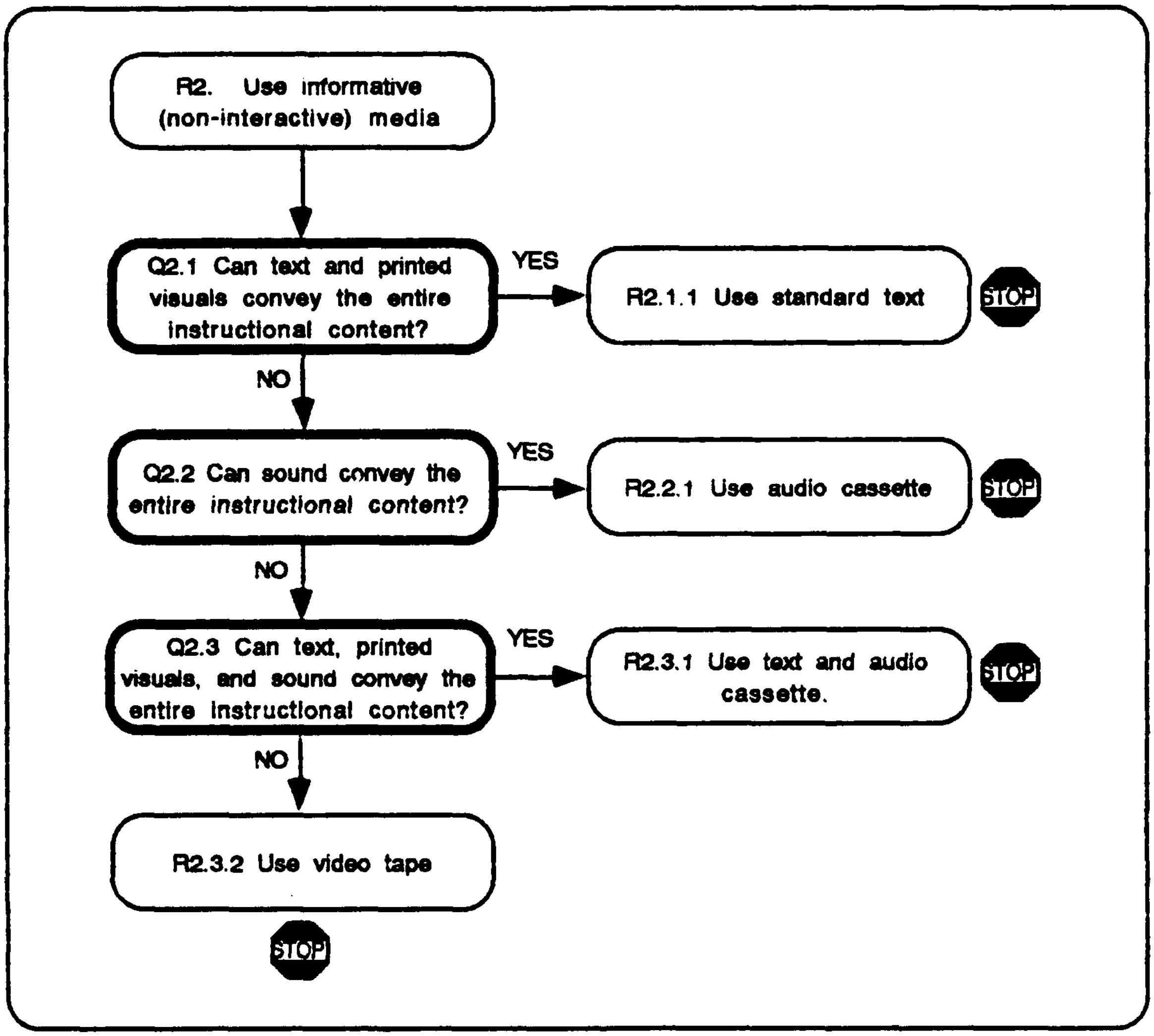

Figure 5.12 Informative Media Decision Sequence

In the fifth step of the process, the designer records the final result—the "Minimal Distance Education Technology"—reached through the media selection decision sequence. He or she enters this solution in the last column of the topic/task analysis worksheet (Figure 5.5).

Clustering of the Learning Topics and Tasks.

Sixth, the designer determines how to cluster the individual learning objectives (topics and tasks) into groups for presentation in class sessions. At this point in the course adaptation process, the delivery plan worksheets have been completed, leaving each learning objective with a separate minimal appropriate delivery technology recommendation (Chapter V). While the worksheets are useful for analysis of learning objectives, it is unrealistic—and undesirable—to present each objective as if in isolation from others in the course. In a resident course, the course designer clusters learning tasks into class periods, or *sessions*. The same must be done for a distance course. In a resident course the designer seeks to cluster compatible learning topics and tasks into the same session and to sequence both the presentation of learning topics within sessions and the order of sessions in the course in a manner that is conducive to learning. Again, the same applies to distance instruction.

The delivery plan summary form (Figure 5.13) provides a place for the course designer to record his or her actions in relation to clustering the learning objectives into sessions and selecting delivery technologies for each session. In completing the summary form, the designer first decides which objectives to include in a session (discussed more fully in the next paragraph) and lists the included objective numbers in the second column of the form*. As each cluster of objectives is identified, sequential numbers (beginning with "1") are entered in the first column. These numbers indicate the order in which the sessions will be taught, but may be resequenced later, if desired. The designer then lists the highest cognitive activity level associated with any objective in the session in

Delivery Plan Summary Sheet

Course Number: ORSC 542 Date:

Course Title: Management and Behavior in Organizations Page 2 of 4

SESSION	LEARNING OBJECTIVE NUMBERS	HIGHEST COGNITIVE LEVEL	COMPLEX TOPICS/TASKS?	MINIMAL DISTANCE EDUCATION TECHNOLOGIES	COMMENTS
1	1 - 6	1.23	4, 5	Text Audioconference	Texts and audio cassettes of lectures provided to enable learners to accomplish readings and hear lectures on all topics prior to an audioconference seminar over all 5 objectives.
2	7 - 10	2.20	7, 10	Text Audiographics or Videoconference	Readings and listening to audio tapes to be accomplished individually prior to one-way video/two-way audio seminar covering all 4 objectives.
3	11 - 16	4.30	13, 14, 16	Text Audiographics	Readings and listening to audio tapes to be accomplished individually prior to audiographics conference (audioconference with graphics provided through fax or electronic blackboard).
4	17 - 23	3.00	19 -23	Text Audiographics (copy-forwarding)	(same as previous session)
5	24 - 28	4.30	24, 26 - 28	Text Audiographics (shared graphics and copy-forwarding)	Readings and listening to audio tapes to be accomplished prior to audiographics conference (electronic blackboard for shared graphics).

Figure 5.13 Delivery Plan Summary Form

column three of the form*. The numbers of objectives with complex topics or tasks are entered in column four*. The delivery technology associated with the objective represented in column three is then entered in column five*. Column six is reserved for any pertinent information not captured elsewhere in the course adaptation process.

The distance course designer should consider at least two matters in clustering learning objectives into sessions. First, the proper sequencing of each topic or task in relation to other topics and tasks is important. Some topics lay groundwork for others and must, therefore, be presented earlier than topics which reference them (18; 43). In other cases, several topics may be introduced concurrently (18; 43). The course designer should also be a subject area expert for the course material. His or her expertise will be required in determining which learning objectives may be presented concurrently, which sequentially, and the order of sequential presentation (15). The second matter of interest in clustering objectives is the minimal distance technologies appropriate for delivery of the objectives (this is now recorded on the worksheets). The designer should first order the objectives according to their logical educational sequence and then examine that sequence to see if some form of delivery-technology-based clustering may be applied without violating logical presentation.

The course designer/subject expert may use the worksheet and media selection tool to match delivery media to each objective. After that, his or her expertise and creativity will be required to cluster the learning objectives into sessions, and to sequence sessions in a manner that balances the twin objectives

* Information taken from the topic/task analysis worksheets.

of logical presentation sequence and use of a consistent delivery medium throughout an entire session—the seventh step in the adaptation process.

In the seventh step, the course designer should choose for an instructional session the most complex delivery technology recommended by the media selection tool for any learning objective addressed during the session. It is not enough to leave each objective with a separate recommended delivery technology. The designer must determine how each delivery session, as a unit of instruction, will be mediated. Selecting the most complex technology required by any objective within the session ensures no objective will be slighted.

This is not to say that the designer should overlook the possibility of assigning readings, audio tapes, video tapes, interactive software lessons, etc., to be accomplished by students in an off-line mode as preparation for, or as a supplement to, live transmitted instruction. Just as reading a text is commonly expected of resident learners prior to attending a resident classroom session, so the reviewing of a text and other material may be required of distance learners prior to any scheduled instructional transmission, especially if the transmission is to be interactive (43).

Course Adaptation Tutorial.

Overview.

The following paragraphs illustrate the application of the course adaptation process to an existing course in the School of Systems and Logistics curriculum. Written as an easy to follow tutorial, the following steps can be

applied by an instructor or course designer who needs to adapt an existing resident course to distance education.

The Sample Course.

The following demonstration starts with a course that: (1) is required for students in several LS programs; (2) has well-defined learning objectives; (3) has a recently prepared and fairly comprehensive topics and tasks plan; and (4) seems to present material that could involve cognitive activities at the level of *application* (3.00 in Bloom's Taxonomy) or higher. ORSC 542, Management and Behavior in Organizations, was selected following an interview of its most recent instructor (43), who verified that it meets the four criteria stated above.

Step 1: Record the objective numbers and the topics and tasks associated with each learning objective in columns 1 and 2 of the topic/task analysis worksheet (Figure 5.14). For ORSC 542 (as for any existing course) these are taken from the syllabus of the existing course*.

Step 2: Record the current methods of presentation for each topic or task in column five of the topic/task analysis worksheet (Figure 5.14).

Step 3: The third step incorporates two activities:

> 3.1 Match each topic or task, one at a time, with the task descriptions in column one of the interaction analysis aid (Figure 5.6), noting the highest cognitive activity level (the number in column two of the interaction analysis aid)

* The instructor, or course designer (if they are not the same person), will already have determined the objectives, topics, and tasks (steps 2 through 4 of the AIS process) for the resident course.

Topic/Task Analysis Worksheet

Course Number: ____________________ Date: __/__/____

Course Title: ____________________ Page ___ of ___

OBJ. NUM.	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
1	Recognize the differences between theory development and testing by (a) academic researchers and (b) applied managers.	1.11	NO	Lecture / text Classroom discussion of students' experiences	Text Audio Cassette
2	Identify the 4 major attributes of an organization.	1.11	NO	Lecture / text	Text Audio Cassette
3	Differentiate between the 3 management levels.	1.23	NO	Lecture / text. Classroom discussion	Text Audio Cassette
4	Differentiate between Mintzberg's 10 managerial roles and the 3 categories into which they are classified. Place each role into the appropriate category.	1.23	YES	Lecture / text Classroom discussion	Text Audioconference
5	Identify the different external enviornment sectors and categorize them as either having a direct impact or an indirect impact on the organization.	1.23	YES	Lecture / text Classroom discussion	Text Audioconference
6	Know the 4 elements presented by Koontz as necessary to disentangle the "management theory jungle."	1.11	NO	Lec' re / text Classroom Discussion	Text Audio Cassette
Column 1	Column 2	Column 3	Column 4	Column 5	Column 6

Figure 5.14 Topic/Task Analysis Worksheet

associated with the topic or task. Enter this number in the third column of the topic/task analysis worksheet (Figure 5.14). Applying the activities of step three to the first learning task ("Recognize the differences between theory development and testing by ..."), consult the interaction analysis aid (Figure 5.6) and determine the highest cognitive activity required of the learner. For example, the instructor might decide that objective one is the learning of *terminology*, level 1.11. Record the cognitive activity level of 1.11 in column three of the worksheet (Figure 5.14).

3.2 Referring again to the interaction analysis aid, determine whether each topic or task may be considered complex by the learners (column three of Figure 5.6) and record this in column four of the topic/task analysis worksheet (Figure 5.14).

In 3.2, above, considering the entrance requirements each learner had to meet (in terms of the standardized aptitude tests), the instructor might conclude that the complexity of this objective is low. Enter "No" in column four of the worksheet for objective one (Figure 5.14).

We are now ready to select the actual distance media required to meet each objective listed in columns 1 and 2 of the Topic/Task Analysis Worksheet. We will apply the process to objective 1, and then repeat the process for each of the other objectives.

Step 4: Place the Topic/Task Analysis Worksheet and the media selection tool side by side on the desk. Reread objective one; then answer question Q1 on

the media selection tool. The level ("1.11" in our sample worksheet) is located in column 3 of the worksheet. Based on this answer ("No"), follow the flow arrow below Q1 on the media selection tool (Figure 5.15) to question Q2. The answer to question Q2 ("No") is in column 4 of the worksheet. The flow arrow for this answer leads to result R2, non-interactive media.

This intermediate result may appear odd, or counter-intuitive. Since the resident course used "Classroom discussion of students' experiences" (Figure 5.14, column 1) to deliver the content of objective one, we might have expected to be led toward *interactive* technologies. The tool is suggesting that this discussion of experiences, while certainly not wrong, exceeds the *minimal technology* needed to accomplish the learning objective.

Look at question Q2.1 (Figure 5.15). Since the lecture offers an essential educational benefit not completely satisfied by "text and printed visuals," answer, "No," to question Q2.1 and follow the logical flow to question Q2.2 (Figures 5.15). Here it is reasoned that while sound is needed, it cannot carry the entire educational message. Answer, "No," to Q2.2 and follow the arrow to Q2.3. Now determine whether sounds and printed material alone can convey the educational content of objective one.

Determining that sound and printed material are sufficient for objective one, answer "Yes" to question Q2.3. Follow the arrow to the right of Q2.3 to result R2.3.1 (Figure 5.15). The minimal technology appropriate to the delivery of objective one is "text and audio cassette." The stop sign to the right of R2.3.1 indicates the end of the media selection process for the learning objective.

Step 5: Record this minimal technology result for objective one in column 6 of the worksheet (Figure 5.14).

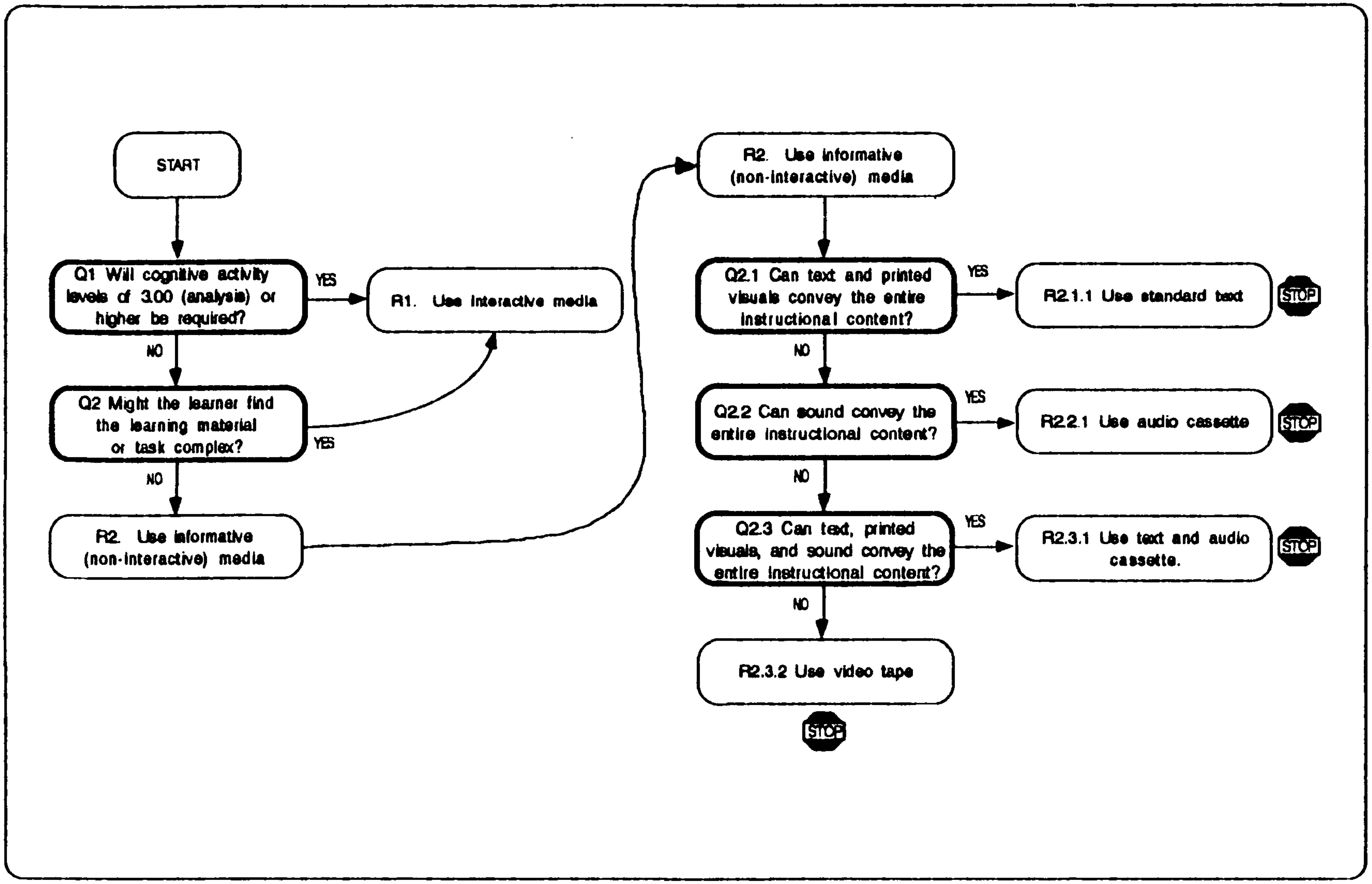

Figure 5.15 Objective 1 Decision Sequence

At this point, repeat steps three, four, and five of the process for each course objective. After completing up through step five for all learning objectives, proceed to step six. Before we discuss steps six through eight, however, consider how the outcome of steps three through five would differ for an objective (topic or task) requiring interaction. Consider objective four:

> Differentiate between Mintzberg's 10 managerial roles and the three categories into which they are classified. Place each role into the appropriate category.

Step 1: Record the objective numbers and the topics and tasks associated with each learning objective in columns 1 and 2 of the topic/task analysis worksheet (Figure 5.14). (This step was completed earlier for objectives one through six.)

Step 2: Record the current methods of presentation for the topic or task associated with objective four in column five of the topic/task analysis worksheet (Figure 5.14). (This step also was completed earlier for objectives one through six.)

Step 3.1: Consulting the interaction analysis aid (Figure 5.6), classify the cognitive activity required as level 1.23, "recall of classifications or categorizations," and mark this in column 3 of the worksheet (Figure 5.14).

Step 3.2: Determine subjectively, based on expertise, professional experience, and knowledge about the learners, that this task could be perceived as complex by the learners. Enter, "Yes," in the column 4 of the worksheet (Figure 5.14).

Step 4: Place the Topic/Task Analysis Worksheet and the media selection tool side by side on the desk. Reread objective four; then answer question Q1 on the media selection tool (Figure 5.16). The level ("1.23" in our sample worksheet)

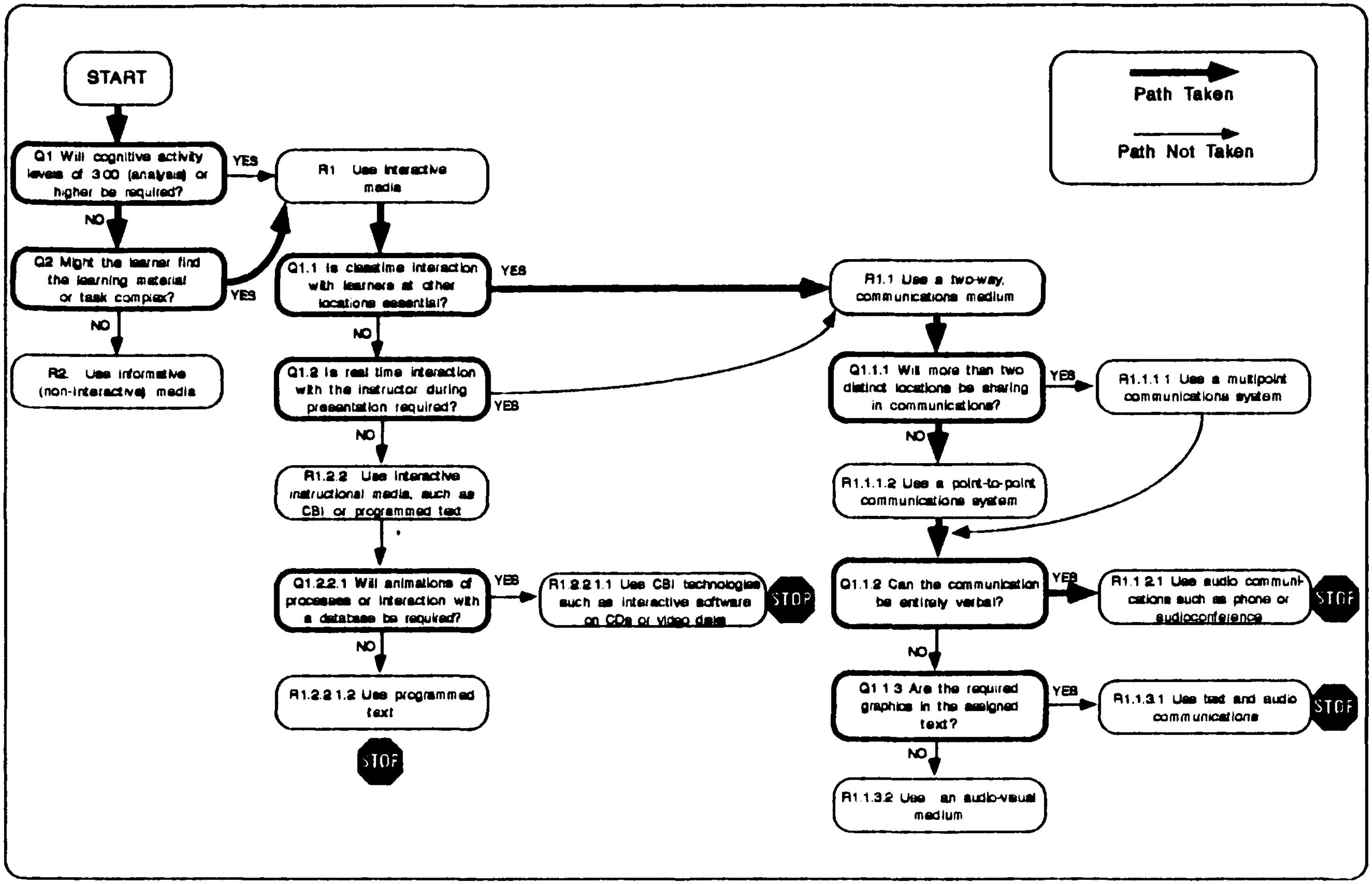

Figure 5.16 Objective 4 Decision Sequence

is located in column 3 of the worksheet. Based on this answer ("No"), follow the flow arrow below Q1 on the media selection tool (Figure 5.16) to question Q2. The answer to question Q2 ("Yes") is in column 4 of the worksheet. The flow arrow for this answer leads to result R1, interactive media.

Working through the remainder of the media selection tool (Figure 5.16), you follow a decision-result sequence of Q1 —» Q2 —» R1 —» Q1.1 —» R1.1 —» Q1.1.1 —» R1.1.2 —» Q1.1.2 —» R1.1.2.1. The solution, "R1.1.2.1," states, "Use audio communications such as phone or audioconference."

Step 5: Record this result for objective four in the column 6 of the worksheet. Since the current presentation method, in column five of the worksheet, includes the use of text (which is standard for LS courses), you also enter "text" in the column 6.

Step 6*: The first six objectives of ORSC 542 were already grouped according to topical compatibility. Evaluation of the grouping of topics and tasks from the first six objectives of the ORSC 542 resident course reveals the existing clustering is suitable. Retain this grouping. Enter the session number, "1," in column one of the delivery plan summary form (Figure 5.13). Enter the range of learning objectives, "1-6," in column two of the same form. Record the numbers of any of the six objectives that were listed as complex (column 4 of Figure 5.14) in column 4 of the summary form (Figure 5.13).

Step 7: In identifying the delivery technology for the session, note from column 6 of the topic/task analysis worksheet (Figure 5.14) that *text and audioconference* is the most complex of the minimal distance education technologies indicated for any of the six objectives. Enter this in column 5 of the

* After completing steps one through five of the course adaptation process for all objectives, proceed to step six, grouping the objectives into sessions.

summary form (Figure 5.13). While examining the worksheet (Figure 5.14), also note that text and audio cassette were suitable for four of the six learning objectives in the session. Text and audioconference were indicated only for the other two objectives. Since much of the material—the four objectives requiring only text and audio cassette—did not require interactive delivery, present these topics as recorded off-line learner preparation for the interactive audioconference session*.

Step 8: Note these decisions in the last column of the delivery plan summary sheet (Figure 5.13).

The Sample Course Plan.

The distance delivery plan for the entire course, ORSC 542, based on the methodology presented in section two of this chapter, is shown in Figures 5.17 - 5.30, below..

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* Identifying some material as preparatory for the on-line session encourages the learners to be better prepared to discuss the more complex concepts during the interactive session and demonstrates the important role of the judgment of the subject area expert in designing distance education programs.

Topic/Task Analysis Worksheet

Course Number: ORSC 542 Date: ___/___/_____

Course Title: Management and Behavior in Organizations Page 1 of 14

OBJ. NUM	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
1	Recognize the differences between theory development and testing by (a) academic researchers and (b) applied managers.	1.11	NO	Lecture / text Classroom discussion of students' experiences	Text Audio Cassette
2	Identify the 4 major attributes of an organization.	1.11	NO	Lecture / text	Text Audio Cassette
3	Differentiate between the 3 management levels.	1.23	NO	Lecture / text. Classroom discussion	Text Audio Cassette
4	Differentiate between Mintzberg's 10 managerial roles and the 3 categories into which they are classified. Place each role into the appropriate category.	1.23	YES	Lecture / text Classroom discussion	Text Audioconference
5	Identify the different external enviorn-ment sectors and categorize them as either having a direct impact or an indirect impact on the organization.	1.23	YES	Lecture / text Classroom discussion	Text Audioconference
6	Know the 4 elements presented by Koontz as necessary to disentangle the "manage-ment theory jungle."	1.11	NO	Lecture / text Classroom Discussion	Text Audio Cassette

Figure 5.17 Worksheet 1

Topic/Task Analysis Worksheet

Course Number: ORSC 542 Date: ___/___/_____

Course Title: Management and Behavior in Organizations Page 2 of 14

OBJ. NUM.	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
7	Know Steiner's five steps for effective long-range planning.	2.20	YES	Lecture / Text Discussion	Text Audioconference
8	Be able to identify and place into the planning function model the four elements of planning outlined in the text.	1.32	NO	Lecture /Text Discussion Graphics	Text Audiographics or Videoconference
9	Understand the critical value, to long-range planning, of setting objectives. Identify and understand the four planning considerations discussed in the text.	2.20	NO	Lecture / Text Discussion	Text Audio Cassette
10	Know the four principal areas in which objectives must be set. Be able to relate each area to military organizational environment.	2.20	YES	Lecture / Text Discussion	Text Audioconference

Figure 5.18 Worksheet 2

Topic/Task Analysis Worksheet

Course Number: OBSC 542 Date: __/__/____

Course Title: Management and Behavior in Organizations Page 3 of 14

OBJ. NUM.	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
11	Differentiate among strategy, goals, objectives, policies, programs, and strategic decisions.	1.11	NO	Lecture / Text Discussion	Text Audio Cassette
12	Understand the concepts of a priori and post priori strategy and the circumstances under which each usually occur or are appropriate.	2.20	NO	Lecture / Text Discussion	Text Audio Cassette
13	Understand Mintzberg's five Ps of strategy. Given an example, be able to identify the particular view of strategy being addressed.	1.23	YES	Lecture / Text Discussion	Text Audioconference
14	Understand the relationship of the organization's history, distinctive competencies, and external environment to its mission statement.	1.23	YES	Lecture / Text Discussion	Text Audioconference
15	Identify those elements which typify an effective mission statement.	1.11	NO	Lecture / Text Discussion	Text Audiocassette
16	Apply the Boston Consulting Group matrix to an organizational situation.	4.30	YES	Lecture / Text Discussion Graphics	Text Audiographics

Figure 5.19 Worksheet 3

Topic/Task Analysis Worksheet	Course Number: ORSC 542			Date: ___/___/_____	
	Course Title: Management and Behavior in Organizations			Page 4 of 14	
OBJ. NUM.	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
17	Differentiate among the various output-oriented and internal operations-oriented bases for departmentalization.	1.23	NO	Lecture / Text Discussion	Text Audio Cassette
18	Understand the concepts of unity of command and span of control. Apply these concepts to structural design.	3.00	NO	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
19	Understand the effects on the organization of varying degrees of complexity, formalization, and centralization.	2.20	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
20	Identify Weber's 10 bases of an ideal bureaucracy.	1.11	YES	Lecture / Text Discussion	Text Audioconference
21	Understand and apply Perrow's technology classification to an organizational example.	3.00	YES	Lecture / Text Discussion Graphics	Text Audioconference
22	Apply Duncan's typology of perceived environmental uncertainty to an organizational example.	3.00	YES	Lecture / Text Discussion Graphics	Text Audioconference
23	Understand the roles of technology, environment, and strategic choice on organizational design.	2.20	YES	Lecture / Text Discussion	Text Audioconference

Figure 5.20 Worksheet 4

Topic/Task Analysis Worksheet

Course Number: OHSC 542 Date: ___/___/______

Course Title: Management and Behavior in Organizations Page 5 of 11

OBJ. NUM	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
24	Know the advantages and disadvantages of each of the arguments about the relationship of strategy and structure: (1) strategy forms structure; (2) structure forms strategy; and (3) strategic choice; and (4) strategic fit.	4.30	YES	Lecture / Text Discussion Graphics	Text Audioconference
25	Know the limitations of strategic choice.	1.11	NO	Lecture / Text Discussion Graphics	Text Audio Cassette
26	Understand Keidel's triangular model of the organization. Apply Keidel's model to a given organization.	4.30	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
27	Differentiate among and relate the following elements of Schreyogg and Steinman's perspective on strategic control: (1) strategic surveillance; (2) premise control; (3) strategy formulation; (4) implementation control; and (5) strategy implementation.	4.30	YES	Lecture / Text Discussion Graphics	Text Audioconference
28	Given a description of an organization, determine appropriate ends and means measures of effectiveness based on Quinn and Cameron's four models of effectiveness.	4.30	YES	Lecture / Text Discussion Graphics	Text Audiographics (shared graphics)

Figure 5.21 Worksheet 5

Topic/Task Analysis Worksheet

Course Number: ORSC 542 Date: ___/___/______

Course Title: Management and Behavior in Organizations Page 6 of 14

OBJ. NUM	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
29	Understand the concept of personality and differentiate among the three factors that influence personality.	2.20	NO	Lecture / Text Discussion	Text Audioconference
30	Understand the importance of different personality attributes. Know what assessment instruments can reveal about a person's personality (MBTI, achievement orientation, locus of control, etc.).	2.20	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
31	Define perception and understand the impact on the perceiver, object, and situation on perception.	2.20	NO	Lecture / Text Discussion	Text Audio Cassette
32	Understand attribution theory. Know the three factors that influence attribution. Apply the theory to a given situation.	2.20	YES	Lecture / Text Discussion	Text Audioconference
33	Trace the development of learning theory and understand the major concepts associated with each theory.	2.20	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
34	Differentiate among the different types of reinforcement and reinforcement timing modes.	2.20	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)

Figure 5.22 Worksheet 6

Topic/Task Analysis Worksheet

Course Number: ORSC 542 Date: ___/___/_____

Course Title: Management and Behavior in Organizations Page 7 of 14

OBJ. NUM.	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
35	Differentiate between motivation and influence.	1.11	NO	Lecture / Text Discussion	Text Audio Cassette
36	Know the four reasons why motivation is important to managers.	1.10	NO	Lecture / Text Discussion	Text Audio Cassette
37	Differentiate between the two major types of motivation theory.	2.20	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
38	Understand Maslow's Hierarchy of Needs and relate it to Alderfer's ERG Theory and Herzberg's Two-factory Theory of motivation.	4.30	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
39	Understand Vroom's Expectancy Theory and apply it to a given situation.	3.00	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)

Figure 5.23 Worksheet 7

Topic/Task Analysis Worksheet Course Number: ORSC 542 Date: __/__/____

Course Title: Management and Behavior in Organizations Page 8 of 14

OBJ. NUM.	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
40	Identify the three reasons why managers should study groups.	1.10	NO	Lecture / Text Discussion	Text Audio Cassette
41	Differentiate among command groups, task groups, friendship groups, committees, and quality circles. Relate the concepts of formal and informal groups to each of these.	1.23	NO	Lecture / Text Discussion	Text Audio Cassette
42	Given a situation, determine the phase of group development and appropriate leader actions.	3.00	YES	Lecture / Text Discussion	Text Audioconference
43	Understand the concepts of norms and cohesiveness and understand how they affect groups.	2.20	YES	Lecture / Text Discussion	Text Audioconference
44	Know Janis' nine recommendations for preventing groupthink.	1.31	NO	Lecture / Text Discussion	Text Audio Cassette

Figure 5.24 Worksheet 8

Topic/Task Analysis Worksheet

Course Number: ORSC 542 Date: ___/___/______

Course Title: Management and Behavior in Organizations Page 9 of 14

OBJ. NUM	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
45	Differentiate among the traditional, behavioral, and interactionist views of conflict. Know the manager's role in each.	2.20	YES	Lecture / Text Discussion	Text Audioconference
46	Given an example, identify the level of conflict and suggest ways in which a manager could improve the situation.	4.20	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
47	Understand the basic focuses of trait theory, behavioral theory, and situational theory in terms of leadership.	4.30	YES	Lecture / Text Discussion Graphics	Text Audiographics (copy-forwarding)
48	Differentiate between the dimensions of two-dimensional behavioral theories.	1.23	YES	Lecture / Text Discussion	Text Audioconference
49	Understand the basic situational factors associated with Fielder's theory, path-goal theory, and Vroom and Yetton's theory of contingency leadership.	4.30	YES	Lecture / Text Discussion	Text Audioconference
50	Present a definition of leadership and defend its validity.	5.10	YES	Lecture / Text Discussion	Text Audioconference

Figure 5.25 Worksheet 9

Topic/Task Analysis Worksheet

Course Number: ORSC 542 Date: ___/___/_____

Course Title: Management and Behavior in Organizations Page 10 of 14

OBJ. NUM	TOPIC/TASK	HIGHEST COGNITIVE LEVEL	COM-PLEX?	BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD	MINIMAL DISTANCE EDUCATION TECHNOLOGIES
51	Define each of the steps in the rational decisionmaking model.	1.32	NO	Lecture / Text Discussion	Text Audio Cassette
52	Given a step in the rational decisionmaking model, offer and argument as to why its implementation could be impossible. (Know the fallacies of the assumptions underlying each step.	4.30	YES	Lecture / Text Discussion	Text Audioconference
53	Differentiate programmed and unprogrammed decisions based on an example.	2.20	NO	Lecture / Text Discussion	Text Audio Cassette
54	Differentiate among uncertainty, certainty, and risk, as defined in the text.	1.10	NO	Lecture / Text Discussion	Text Audio Cassette
55	Given an example, be able to identify which of the six common biases affecting decisionmaking is being addressed.	2.20	NO	Lecture / Text Discussion	Text Audio Cassette

Figure 5.26 Worksheet 10

Topic/Task Analysis Worksheet	Course Number: ORSC 542 Course Title: Management and Behavior in Organizations			Date: ___/___/______ Page 11 of 14	
OBJ. NUM	**TOPIC/TASK**	**HIGHEST COGNITIVE LEVEL**	**COM-PLEX?**	**BRIEF DESCRIPTION OF CURRENT PRESENTATION METHOD**	**MINIMAL DISTANCE EDUCATION TECHNOLOGIES**
56	Differentiate among French and Raven's five sources of power as well as the other sources of power discussed in class.	2.20	YES	Lecture / Text Discussion	Text Audioconference
57	Understand the relationship between power and authority.	2.20	NO	Lecture / Text Discussion	Text Audio Cassette
58	Define and understand politics.	1.11	NO	Lecture / Text Discussion	Text Audio Cassette
59	Relate the concepts of politics and power to the rational decisionmaking model.	4.30	YES	Lecture / Text Discussion	Text Audioconference
60	Differentiate between power as personal possession and power as organizational possession.	2.20	YES	Lecture / Text Discussion	Text Audioconference
61	Know the techniques for obtaining power, as discussed in class.	1.31	NO	Lecture / Text Discussion	Text Audio Cassette

Figure 5.27 Worksheet 11

Delivery Plan Summary Sheet

Course Number: ORSC 542 Date: ___/___/_____

Course Title: Management and Behavior in Organizations Page 12 of 14

SESSION	LEARNING OBJECTIVE NUMBERS	HIGHEST COGNITIVE LEVEL	COMPLEX TOPICS/TASKS?	MINIMAL DISTANCE EDUCATION TECHNOLOGIES	COMMENTS
1	1 - 6	1.23	4, 5	Text Audioconference	Texts and audio cassettes of lectures provided to enable learners to accomplish readings and hear lectures on all topics prior to an audioconference seminar over all 5 objectives.
2	7 - 10	2.20	7, 10	Text Audiographics or Videoconference	Readings and listening to audio tapes to be accomplished individually prior to one-way video/two-way audio seminar covering all 4 objectives.
3	11 - 16	4.30	13, 14, 16	Text Audiographics	Readings and listening to audio tapes to be accomplished individually prior to audiographics conference (audioconference with graphics provided through fax or electronic blackboard).
4	17 - 23	3.00	19 -23	Text Audiographics (copy-forwarding)	(same as previous session)
5	24 - 28	4.30	24, 26 - 28	Text Audiographics (shared graphics and copy-forwarding)	Readings and listening to audio tapes to be accomplished prior to audiographics conference (electronic blackboard for shared graphics).

Figure 5.28 Summary Form 1

Delivery Plan Summary Sheet

Course Number: ORSC 542 Date: ___/___/_____

Course Title: Management and Behavior in Organizations Page 13 of 14

SESSION	LEARNING OBJECTIVE NUMBERS	HIGHEST COGNITIVE LEVEL	COMPLEX TOPICS/TASKS?	MINIMAL DISTANCE EDUCATION TECHNOLOGIES	COMMENTS
6	29 - 34	2.20	30, 32 - 34	Text Audiographics (copy-forwarding)	Readings and listening to audio tapes to be accomplished individually prior to audiographics conference (audioconference with graphics provided through fax or electronic blackboard).
7	35 - 39	4.30	37 - 39	Text Audioconference	(same as previous session)
8	40 - 44	3.00	42, 43	Text Audiographics (copy-forwarding)	Readings and listening to audio tapes to be accomplished individually prior to audioconference seminar.
9	45 - 50	5.10	45 - 50	Text Audiographics (copy-forwarding)	Readings and listening to audio tapes to be accomplished individually prior to audiographics conference (wih fax or electronic blackboard).

Figure 5.29 Summary Form 2

Delivery Plan Summary Sheet

Course Number: ORSC 542 Date: ___/___/_____

Course Title: Management and Behavior in Organizations Page 14 of 14

SESSION	LEARNING OBJECTIVE NUMBERS	HIGHEST COGNITIVE LEVEL	COMPLEX TOPICS/TASKS?	MINIMAL DISTANCE EDUCATION TECHNOLOGIES	COMMENTS
10	51 - 55	4.30	52	Text Audioconference	Readings and istening to audio tapes to be accomplished individually prior to audioconference seminar.
11	56 - 61	4.30	56, 59, 60	Text Audioconference	(same as previous session)
					NOTE 1: All stated objectives, except shared graphics update access, can be met by the near future satellite video capability, pending installation of AFIT's uplink installation. Therefore, the need for shared graphics update in session 5 should be reconsidered. NOTE 2: Regardless of the technology used, text and audio or video cassette recordings will be provided to students to review as preparation for the interactive sessions.

Figure 5.30 Summary Form 3

Summary of the Chapter

Four main sections were presented in this chapter. The first was a discussion of the AFIT Academic Instructional System (AIS)—the system employed at AFIT for identifying educational requirements and designing and improving instructional systems. The second section discussed the concept of cognitive activities, as presented in Bloom's Taxonomy of Cognitive Categories. The section also explored the relationship among cognitive activities, topic or task complexity, and the need for interaction. The third section presented the specific methodology proposed for adapting School of Systems and Logistics resident courses for delivery by distance education technologies. The methodology consisted of preparatory steps, an algorithmic process, and steps for clustering individual objectives into sessions (and their associated off-line learning tasks, such as preparatory reading). The last section provided an abbreviated demonstration, applying the course adaptation process to objectives of an actual School of Systems and Logistics course.

Chapter VI

Conclusions and Recommendations

Chapter Overview

It was the objective of this research, given a knowledge of distance education methods and principles of academic instructional systems, to demonstrate how AFIT's existing or near future resources can be applied to effective real time distance delivery of a School of Systems and Logistics resident course that requires interaction between instructor and students. The conclusions derived from the research fall into topical groups. Each conclusion is accompanied by its rationale and by any recommendations that follow from it.

AFIT's Distance Education Potential

Conclusion 1. AFIT possesses the resources necessary to provide viable real time interactive and recorded non-interactive distance education programs.

Rationale.

1. A precedent for offering live distance education exists. AFIT faculty and media production specialists have demonstrated the willingness and skills necessary to making past distance offerings successful. AFIT's success with these suggests a smooth transition to future distance education offerings.

a. AFIT/LS has offered SYS 200, a PCE course, via cable to Area A of WPAFB. From the instructor's perspective, teaching over satellite would be no different (the difference between cable and satellite technology would be virtually transparent to the instructor) than teaching via cable.

b. AFIT/LS offered SYS 200 to distant sites via a leased satellite uplink station during the spring of 1991.

c. AFIT/LS offered MATH 525 (Statistics I), a graduate course, via closed circuit television, with telephone audio links, during the summer 1991 academic quarter.

2. AFIT possesses resources for the production of professional quality live instructional broadcasts. These include a television studio, television video cameras for classroom use, and experienced television media specialists.

3. AFIT possesses resources for recording instruction in text (including graphics), sound (audio cassette), and/or full-motion video (video cassette) formats.

4. AFIT possesses the subject expertise, technical expertise, and the technology required to produce educational software.

5. AFIT will soon have its own satellite uplink station, enabling it to transmit live and recorded courses (one-way video) to any facility with a receiving station*. AFIT/LS has plans underway for providing PCE courses to the Air Force civilian scientific and engineering community by satellite distance education, using the new uplink station. The arrangements (telecommunications services contracts) for these courses will pave the way for other potential AFIT course offerings, including graduate program courses.

6. AFIT Plans and Programs (XP) offers faculty training to develop the skills for producing quality live broadcast or recorded instruction.

Recommendation 1. In the absence of findings contrary to AFIT's prior investigations of and experiences in distance education, and in light of the findings of this research, it is recommended that AFIT continue and accelerate its use of distance education to meet its goals.

Conclusion 2. There is nothing in the research to contradict the possibility of offering one or more entire degree programs by distance education.

Rationale. In chapter four, the idea of a non-thesis master's of operations management degree program was presented as a possible first complete degree that LS could offer by distance education. In addition to distance education being less expensive per student than resident education, it

* AFIT will still have to contract with commercial communications companies for transponder use and for lease of audio lines, but will no longer have to rent uplinks (as was done with SYS 200)—the major expense in satellite education.

offers time and schedule constrained officers the ability to gain a useful degree at a timely point in their careers without requiring them to leave the mainstream of their careers for a prolonged period. Since many officers, especially those who are rated and want to continue flying, are probably not interested in education beyond the masters degree, non-thesis programs could be considered.

Recommendation 2. It is recommended that AFIT and LS evaluate the possibilities for using distance education to provide some DOD graduate education programs and for enhancing the qualifications of Air Force officers who would not normally attend an AFIT degree program in residence. As the pool of graduates increases, the continuity of such programs could be continuously improved. by using their graduates as on-site facilitator/coordinators of such programs.

Conclusion 3. AFIT does not currently possess a formal structure for producing educational software (although it possesses the subject and technical expertise and the technical facilities to do so).

Rationale. Interactive software can be created using the personal computers and workstations already owned by AFIT. Such programs can be written in the standard programming languages already available* and can be distributed on inexpensive standard floppy disk media.

* For a small investment (under $1,000) AFIT could acquire course construction software enabling non-programmers to create interactive educational software.

Recommendation 3. AFIT should consider establishing (staffing) an office, within instructional media, whose purpose would be the production of interactive educational software.

Conclusion 4. AFIT possesses organizational change-management consultants who are attuned to the dynamics and processes inherent in organizational evolution. They represent a valuable resource for the transitions AFIT will face in incorporating distance education.

Rationale. Potential or inevitable organizational changes concern many people representing a variety of perspectives and possible mental reservations. The organizational scientists on the LS staff are familiar with the effects of organizational changes and with techniques for helping personnel adjust to changes.

Recommendation 4. AFIT should consider the potential benefits to be gained by involving its organizational specialists in planning distance education policies and applications, in order to avert or minimize the possible negative reactions of AFIT personnel.

Methods and Procedures

Conclusion 5. The semantic network software (SemNet™) used to organize information gathered from literature and interviews demonstrated several qualities which suggest how it might best aid similar research (i.e., research into a broad field in which the researcher has little or no background) in the future.

a. SemNet™ proved ideal for rapidly recording large numbers of propositions (such as "Magnetic Media - include - Video Cassette Tape") in a manner that: (1) did not slow the research; (2) did not require any preconceptions about the structure of knowledge in the domain of interest; and (3) did not even require immediate understanding of the concepts, the propositions, or their relative importance.

b. SemNet™ did not offer any facility for highlighting the relative importance of different concepts (other than frequency of occurrence). In the structure of the emerging semantic network, every concept appeared equal with every other. (This is one reason concept mapping was selected to represent the key concepts in the research—to indicate the hierarchy of relative importance among the concepts.) This lack of distinction by concept significance had both positive and negative effects on the research. On the negative side, in some cases too much time was spent investigating relatively unimportant concepts and propositions. This could cause real problems in a more time-constrained research environment. On the positive side, some concepts and propositions that might have otherwise been overlooked as seemingly insignificant were investigated more thoroughly as interesting relationships emerged. Some of these proved to be important. In this respect, SemNet™ may have reduced the effects of unconscious bias in the research.

Recommendation 5. SemNet™ may be useful for applications in which a researcher must build a knowledge base from unfamiliar information—especially when time may be very limited and the amount of information to be gathered is large. One such application would be expert knowledge acquisition.

Preparation of Courses for Distance Delivery

Conclusion 6. The course designer needs a more specific approach to use in conjunction with the AIS in designing distance courses.

Rationale. The Academic Instructional System (AIS) was not designed with distance education in mind, but presents no problems in being applied to distance education. The AIS is a general model. Its steps do not provide a specific methodology for designing either resident or distance courses, but offers a general approach in which the educational designer is free to employ whatever specific techniques best meet the needs identified in steps 1 (identification of requirements) and 2 (definition of requirements and identification of student output) of the AIS. The media selection tool may be used in conjunction with the AIS to meet this need.

Recommendation 6. It is recommended that AFIT develop, and apply to the design of its distance education applications, tools such as the media selection tool presented in this research.

Conclusion 7. The results provided by the media selection tool could not always be anticipated beforehand.

Rationale. Walking through the logical process of applying the media selection tool to each topic or task can bring to light characteristics of the learning objectives that were not obvious, giving the course designer opportunities to more fully exploit learning opportunities by adjusting the content, nature, or sequencing and grouping of topics and tasks.

Recommendation 7. In using the media selection tool, course designers should follow all steps for each identified learning objective (topic or task).

Conclusion 8. Each frame of the media selection tool may be understood, used, evaluated, and modified individually without necessarily outmoding other frames.

Rationale. The modular structure of the media selection tool enables each of its separate frames and decision points to be treated individually. This should contribute to the maintainability and usability of the tool, as well as making it suitable for automation.

Recommendation 8. It is recommended that the media selection tool be incorporated, either by an AFIT office or as a student project, into a computer program. This should speed the course design process by providing for data input from the keyboard and by automating worksheet and forms completion and media identification. Software could also perform useful searches and comparisons automatically, aiding the course designer's analysis of the course objectives.

Conclusion 9. When course topics and tasks are complex and of a high cognitive level, or when the learner's confidence (indicated by low self-direction, low motivation, and other personal characteristics) is low, real time interaction can enhance learning and mitigate perceived (psychological) distance.

Rationale. The literature and interviews (Chapter 3) indicated the importance of real time interaction for effective distance education increases when either (1) the difficulty of the topics and tasks increases, or (2) the student, for psychological reasons or because of lack of knowledge or skills, is uncomfortable with the perceived separation from the instructor. Real time interaction can address both the instructional and the psychological needs of learners.

Recommendation 9. It is recommended that AFIT's distance education planners and course designers consider the potential importance of real time interaction in distance education applications.

asynchronous communication — for the purpose of distance education, refers to two-way, one-at-a-time communication. Examples would include E-mail and regular mail (33:103).

audio cassette — encased magnetic tape storage medium for recording and sound (analog) signals (18:20).

audiographics (audio-graphics) teleconference — a type of teleconferencing which uses "narrowband telecommunications channels to transmit visual information such as graphics, alpha-numerics, documents, and video pictures as an adjunct to voice communication". Synonyms: audio plus, desktop computer conferencing, enhanced audio. "Devices include electronic tablets and boards, freeze-frame video terminals, integrated graphics systems (as part of personal computers), Fax, remote-access microfiche and slide projectors, optical graphic graphic scanners, and voice/data terminals." (48:4)

audio teleconference — see *conference call.*

bandwidth — "the capacity of a communication channel. A channel's bandwidth is the difference between the highest and lowest frequencies that are carried over the channel. The higher the bandwidth, the more information can be carried." (28:21).

baseband transmission — a method of digital transmission of unmodulated "data signals ... over the physical communication medium in the form of discrete pulses of electricity or light" (42:45; 28:19); data signals along a channel via voltage fluctuations; effectively restricts a conducting medium to single-channel performance (17:20).

broadband (also *wideband*) — a frequency band that can be subdivided into subordinate bands for some purpose (17:18).

broadband transmission — analog signalling in which high frequency carrier waves allow multiple channel transmission; one medium may be used to address a variety of transmission requirements (28:19; 42:45).

cable systems — communications systems which use coaxial cable to interconnect participating sites (8:31).

coaxial cable — "A transmission medium consisting of one or two central data transmission wires surrounded by an insulating layer, a shielding layer, and an outer jacket. Coaxial cable has a high data carrying capacity and low error rates" (42:537).

codec (coder-decoder; digitizer) — device or circuit that converts analog signals into digital format and back into analog format (17:43).

compressed video — each conference site transmits and receives audio and limited motion video; video is of lower quality than that possible through full bandwidth transmission; uses leased T1 lines (8:32; 14:38).

computer based instruction (CBI) - presents educational content in an interactive computer program, usually stored on magnetic, optical, or magneto-optical media, and which may be copied to the fixed (hard) disk of a personal computer (38).

computer mediated instruction — the use of computers to help automate knowledge/skill level diagnosis, topic/task prescription, instructional module design, and learner progress monitoring (11).

computer (tele-)conference — "usually uses telephone lines to connect two or more participants through computers. Anything that can be done on a computer can be sent over the lines. It can be synchronous or asynchronous. A common example is electronic mail (E-mail)." (48:4)

concept mapping — a two-dimensional schematic knowledge representation technique that represents concept meanings by locating the concepts in a hierarchical framework of concept-relation-concept (proposition) sets (37:15).

conference call (audio teleconference) — A type of "multi-point audio interaction"; "an interactive session involving several sites simultaneously" achieved "through a long distance operator or an audioconferencing bridge" (8:30). "Voice-only communication .... interactively links people in remote locations via ordinary telephone lines. Systems include telephone conference calls and audio bridges that tie all lines together" (48:4). It consists of "two-way electronic voice communication between two or more groups, or three or more individuals, who are in separate locations" (14:31).

control — "opportunity and ability to influence, direct, and determine decisions related to the educational process. ... achieved by ... a balance between independence", power, and support through two way communication (18:18).

dialog — "communication during the instructional transaction (learning phase) and is concerned with the student's intellectual, physical, and emotional needs for learning." (18:23).

distance — 1. physical separation or remoteness; 2. separation in time; 3. psycho-social (perceived) remoteness. Distance can be assessed in terms of the types and degrees of *structure* and *dialog* involved in the distance education process (18:23).

electronic mail (E-mail) — (see computer teleconferencing)

facilitator — "individual responsible for the local component at a teleconference site" (14:34) or distance education remote site. "May or may not be an expert in the subject matter" (14:34).

fiber optic — denotes use of optical fiber (see *optical fiber lines*)

geostationary (geosynchronous) orbit — an orbit approximately 22,300 miles above the earth's equator which permits communications satellites to maintain a constant position and altitude in relation to a point located on the earth's equator. Three equally-spaced geostationary satellites provide worldwide transmission coverage (excluding polar extremities). Geostationary satellites must be separated by at least 4º of arc to prevent interference of signals (48:4; 42:50-51).

hand-held response unit — portable device which enables remote learners to respond to instructor queries, ask the instructor questions, otherwise signal the instructor; possesses a keypad with numeric and other response or signalling keys, a display, various indicators (call in queue, call on line, etc.), and perhaps a microphone for voice communications (11).

independence — "degree of control learners exert over the context and method of their learning"; freedom from the influence of others" (18, 16).

independent learning — learning "'carried on wholly or largely independently of outside direction or control, characterized by learner autonomy and distance from educational authority'" (Garrison, quoting Wedemeyer,1981 [18:16]).

integrated services (signals integration) — transmission of all signals (data, voice/sound, text, and video) in digital form over a single medium (8:31; 41:12-16).

Integrated Services Digital Network (ISDN) — "an evolving set of standards for unifying a broad range of voice, data, text and image communication services in one digital wide area network." (41:12).

interaction (interactivity) — reciprocal action or communication between a learner and a source of instruction (instructional material or instructor), between learners and instructors, or among learners (46:955; 33:100-101); "the capability to talk back" (*Ed*, Sep 1990, 4); essential to learning; includes: (1) interaction with course content, (2) interaction with the instructor (which may be a machine), and (3) interaction with other students (5:11).

leased lines — Voice-grade lines "leased from common carriers" which may also be used for data transmission when moderate error rates are acceptable. Justified "when the connection time between locations is long enough to cover the cost of leasing or if speeds higher than those available with switched lines must be attained." The cost depends on transmission speed, distance, and degree of line conditioning to reduce data error rates. Conditioned leased lines are less error-prone than switched lines (42:44, 111, 539).

line conditioning (equalization) — "the process of improving the data carrying characteristics of a leased telephone line" (42:111; 17:89).

line of sight — a straight, unobstructed line exists between sending and receiving stations; a requirement for microwave transmissions (42:48).

media — "intervening substance through which something is transmitted or carried on" (4:815).

microwave transmission — see *terrestrial microwave*.

modem (data set) — device that translates signals "from digital to analog and back to digital format"; enables computers (digital) to communicate over analog telephone lines; must be used in identically configured pairs (42:61, 66).

motorized systems — (satellite communications) "receives programs on different satellites by moving the dish which is connected to a position adjustment device in the control room." *Automated systems* are motorized systems that are "controlled by a microprocessor to allow instant movement to different satellites whose positions are stored in memory." (48:5)

optical fiber lines — "lines composed of glass fibers that carry information as light pulses." "can carry enormous amounts of information in comparison to conventional ... wire" (8:31).

picture phone — communication technology in which "audio is accompanied by regularly updated single frames of video from each end of the line" (8:32). (see *still image video*)

point-to-multipoint communications — a signal from a single origin point is received by multiple receivers; typical of broadcast transmissions such as satellite down-links and radio transmissions (48:5).

point-to-point communications — a signal from a single origin point is received by a single receiver.

power — "the ability or capacity to take part in or assume responsibility for the learning process. Without the requisite intellectual ability, study skills, or motivation to be involved independently in a learning process the individual cannot be in control of the learning situation" (18:20).

presentation — instructor communication of the instructional material, "including information, skill demonstration, and attitude and value modeling" (33:101-102; 8:30).

real time interaction — that characteristic of an educational delivery system which provides the opportunity for immediate feedback or communication

between the learner and instructor (or automated instruction medium, such as interactive computer based instruction) or among learners.

remote student — a distance learner.

satellite communications (satellite transmission) — transmission of data of any type via satellite. Components are the earth stations (surface send/receive points) and transponders (orbital send/receive devices). "broad scale transmissions via C-band and Ku-band geosynchronous communications satellites" (8:31).

satellite footprint — the area of the earth's surface which may be reached by transmissions from a satellite; "communications satellites have direct line-of-site to almost half the earth." (48:4).

satellite receivers — "convert satellite signals into channels that can be viewed (one channel at a time) on a TV monitor. A receiver must be designed to tune-in the format, bandwidth, and audio sub-carrier that will be viewed." "Basic Receivers: Lowest cost; limited channel tuning capability .... Usually combined with fixed antennas to form an inexpensive system package" "Multi-Format Receivers: Most versatile; have adjustments for every broadcast format, and can receive any satellite video program in six or more bandwidth selections, and two agile audio subcarrier switches; usually used with motorized systems" (48:4). (see *motorized systems*)

shared graphics environment (shared visual space) — "Allows participants to interact with a common graphics display area; e.g., any person can make a change which is seen by all" (48:4).

slow scan video (slow scan TV) — "A device that transmits and/or receives still video pictures over a narrowband ... channel" (14:38); "single frames of video are transmitted over standard telephone lines." (8:32) .

speaker phone — a telephone which has, instead of or in addition to the standard handset, a multi-directional microphone and a speaker; enables more than one person at a site to simultaneously hear and speak to the other site (8:30).

still image video — any technology which transmits still images over standard telephone lines; often permit real-time interaction (14:38). (see *slow scan video* and *picture phone*.)

structure — a communication variable of distance education that is "concerned with the flexibility of the program. It also appears to reflect the degree to which the teacher determines the objectives, content, and strategies" (34:11; 18:23).

support — "resources the learner can access ... to carry out the learning process" (courses, teachers/facilitators, materials, experts, reference materials, media, financial, emotional, etc.. [18:20]).

switched lines (switched connections) — use of existing telephone wire circuits and switching facilities to connect a sender and receiver; a voice-quality connection which may also be used for data transmissions of limited speed, size, quality, and duration; should be considered when "the amount of information to be transferred is small, and the number of locations may be large or changeable" and a moderate amount of data errors are acceptable. More error-prone than conditioned leased lines (42:111, 43-44).

synchronous communication - for the purpose of distance education, this refers to two-way, simultaneous communication. Examples include a normal telephone conversation, packet radio (cellular telephone), teleconferencing, and videoconferencing (33:103).

teleconference — "Electronic communications between two or more groups, or three or more individuals, who are in separate locations via audio, audiographics, video and computer" (14:18).

terrestrial microwave — a high frequency radio technology with line of sight transmission at up to 45 Mbps used for voice-grade and/or high-speed data transmission (42:48-49; 8:31).

transponder — (satellite communications) "receives the transmission from earth (up-link), amplifies the signal, changes frequency, and retransmits the data to a receiving earth station (down-link)." (42:545) Receives and transmits "Video, audio, or data signals .... There may be 24 or more transponders per satellite" (48:4).

twisted pair wire — ordinary telephone wire consisting of a pair of wires "twisted together to minimize signal distortion from adjacent wire pairs in the sheath" (42:43) .

two-way audio — simultaneous voice communication between two sites.

two-way video — simultaneous video transmission between two sites; the "instruction site and classroom site(s) can see as well as hear what is going on at other sites. This allows for ... interaction that more closely approximates that in the physical classroom" (8:32). Very costly alternative.

very small aperture terminal (VSAT) — (satellite technology) "Small earth station with a satellite dish usually 4 to 6 feet (1.2 to 1.8 meters) in diameter used to receive high speed data transmission; can also transmit slow-speed data" (48:18).

video — equipment or techniques used in presenting data or other images on viewing screens; actual image medium may be tape, compact disk, floppy disk, fixed disk, optical disk or other digital or analog medium (8:31-33; 17:316).

video cassette — magnetic medium capable of storing and replaying recorded visual and sound signals.

video teleconference — "Combines audio and video to provide voice communications and video images. Can be one-way video/two-way audio, or two-way video/two-way audio. It can display anything that can be captured by a TV camera. The major advantage is its ability to display moving images. The most common application is to show pictures of people which creates a social presence that resembles face-to-face meetings and enables participants to see the facial expressions and physical demeanor of participants at remote sites. There are three basic types of video teleconferencing systems: freeze frame, compressed, and full-motion video." (48:4)

Appendix B: The Distance Education Model

Introduction to the Distance Education Model

This section presents a conceptual model of distance education. The model does not attempt to capture every concept that applies to distance eduction. It represents, rather, the most important concepts in terms of two criteria: (1) emphasis in the literature and from interviews; and (2) possible applicability to the delivery of LS resident courses by distance modes.

The Map Directory

Following concepts and relationships across a number of separate pages of concept maps can be difficult if no other navigational aids are available. A single-page map of concepts central to distance education would be too large and cumbersome to publish. To make referencing the various maps of the conceptual model of distance education more convenient, the reader is offered the following directory of key concepts.

Hierarchy of the Distance Education Model

0.0	Distance Education	Map 1
1.0	Distance	Map 2
1.1	Actual Distance	Map 2
1.1.1	Separation in Time	Map 2
1.1.2	Physical Separation	Map 2
1.2	Perceived Distance	Map 2
1.2.1	Psychological Separation	Map 2
2.0	Institution's Goals	Map 3
2.1	Joint Ventures	Map 3
2.2	Educational Access	Map 3
2.3	Individualized Learning	Map 3
2.4	Throughput	Map 3
2.5	Use of Existing Investments	Map 3
2.6	Equalize Access to Quality	Map 3
2.6.1	Best Qualified Faculty	Map 3
2.6.2	Professionally Prepared Instruction	Map 3
3.0	Learner	Map 4
3.1	Personal Traits	Map 4
3.1.1	Intellectual Ability	Map 4
3.1.2	Psychological Traits	Map 4
3.1.2.1	Motivation	Map 4
3.1.2.2	Emotional Maturity	Map 4
3.1.2.3	Values	Map 4
3.1.2.4	Self-Concept	Map 4
3.1.2.5	Attitude	Map 4
3.1.2.6	Cognitive Learning Style	Map 4
3.1.3	Learning Skills	Map 4
3.2	Control	Map 4
3.2.1	Educational Context	Map 4
3.2.2	Self-Directed Learning	Map 5
3.2.2.1	Technique Acquisition	Map 5
3.2.2.2	Skill Acquisition	Map 5
3.2.2.3	Self-Reflection	Map 5
3.2.2.4	Creation of Meaning	Map 5
3.2.2.5	Change of Consciousness	Map 5
3.2.2.6	Critical Thinking	Map 5
3.2.3	Educational Process	Map 4
3.2.3.1	Learning Objectives	Map 4
3.2.3.2	Learning Activities	Map 4

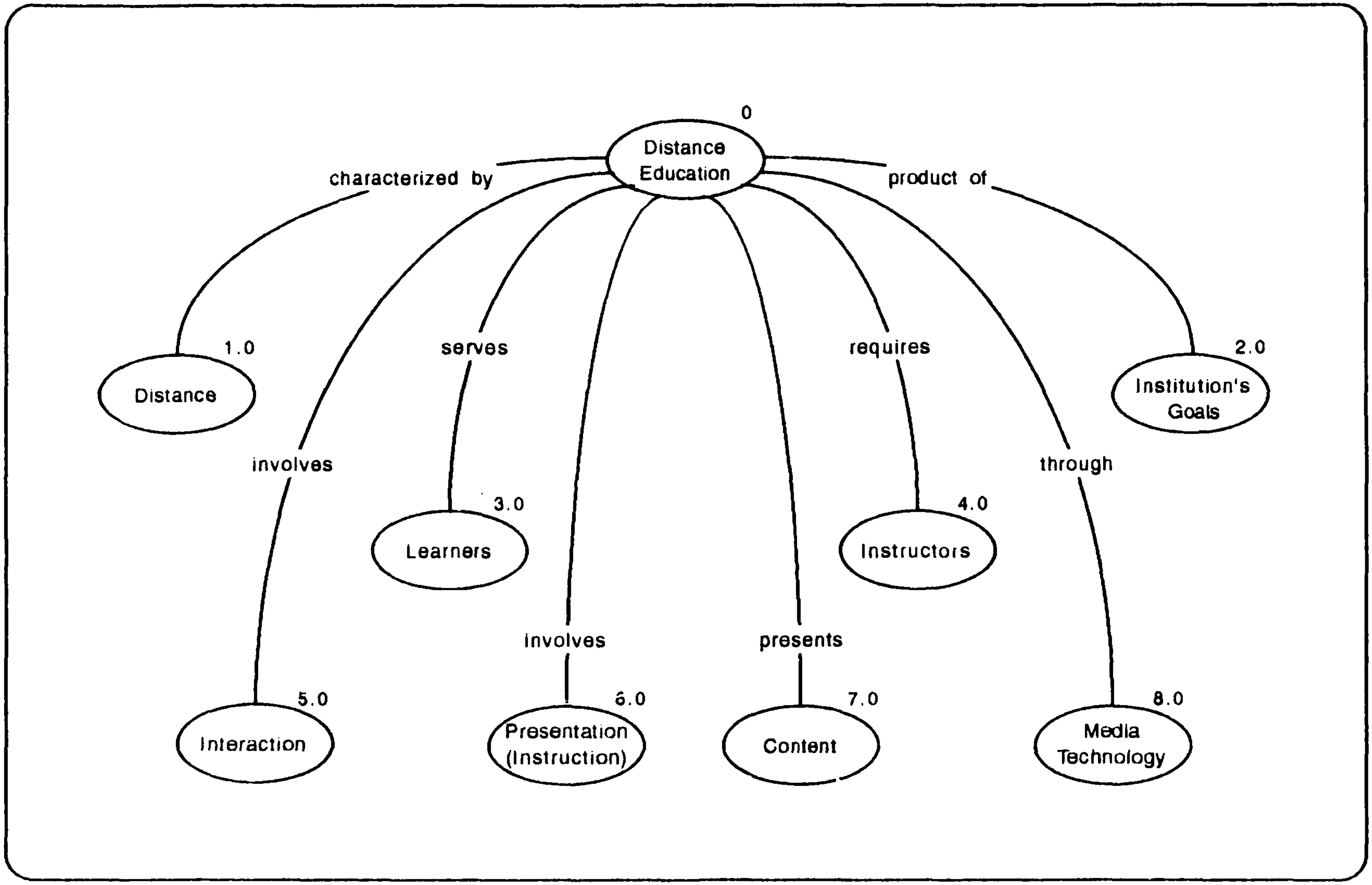

Figure B.1 (Map 1) Root Map—Distance Education

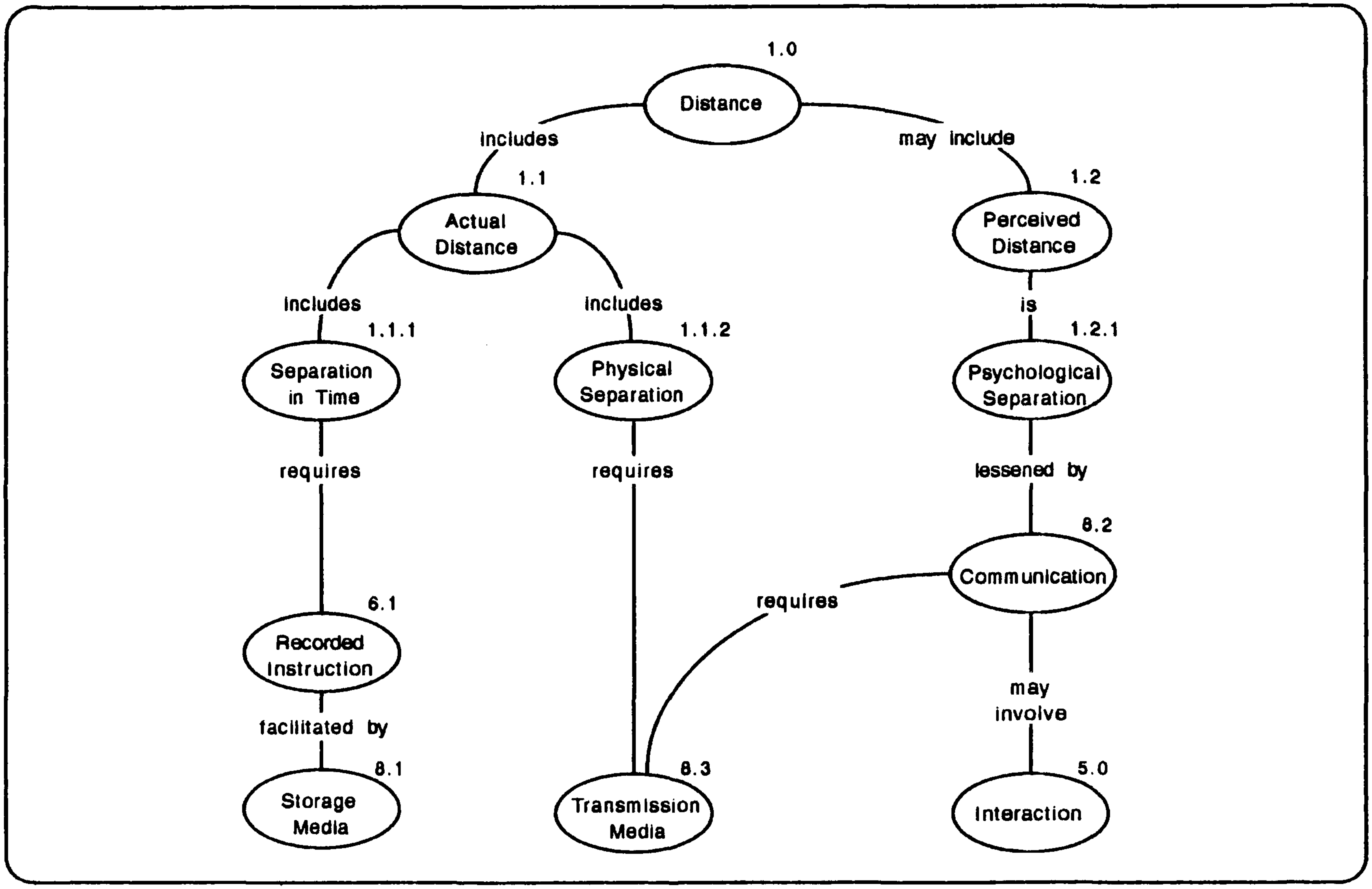

Figure B.2 (Map 2) Distance

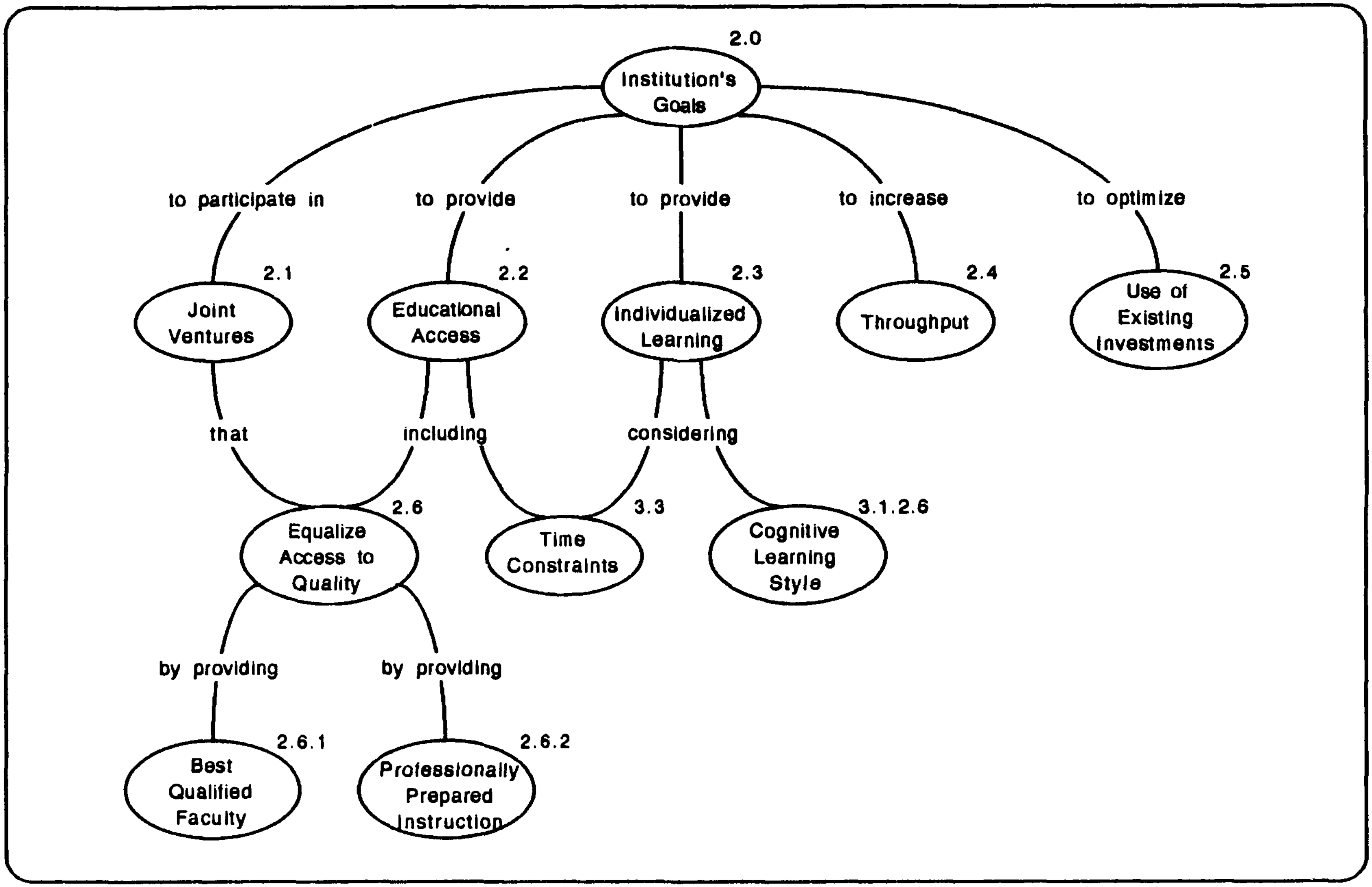

Figure B.3 (Map 3) Institution's Goals

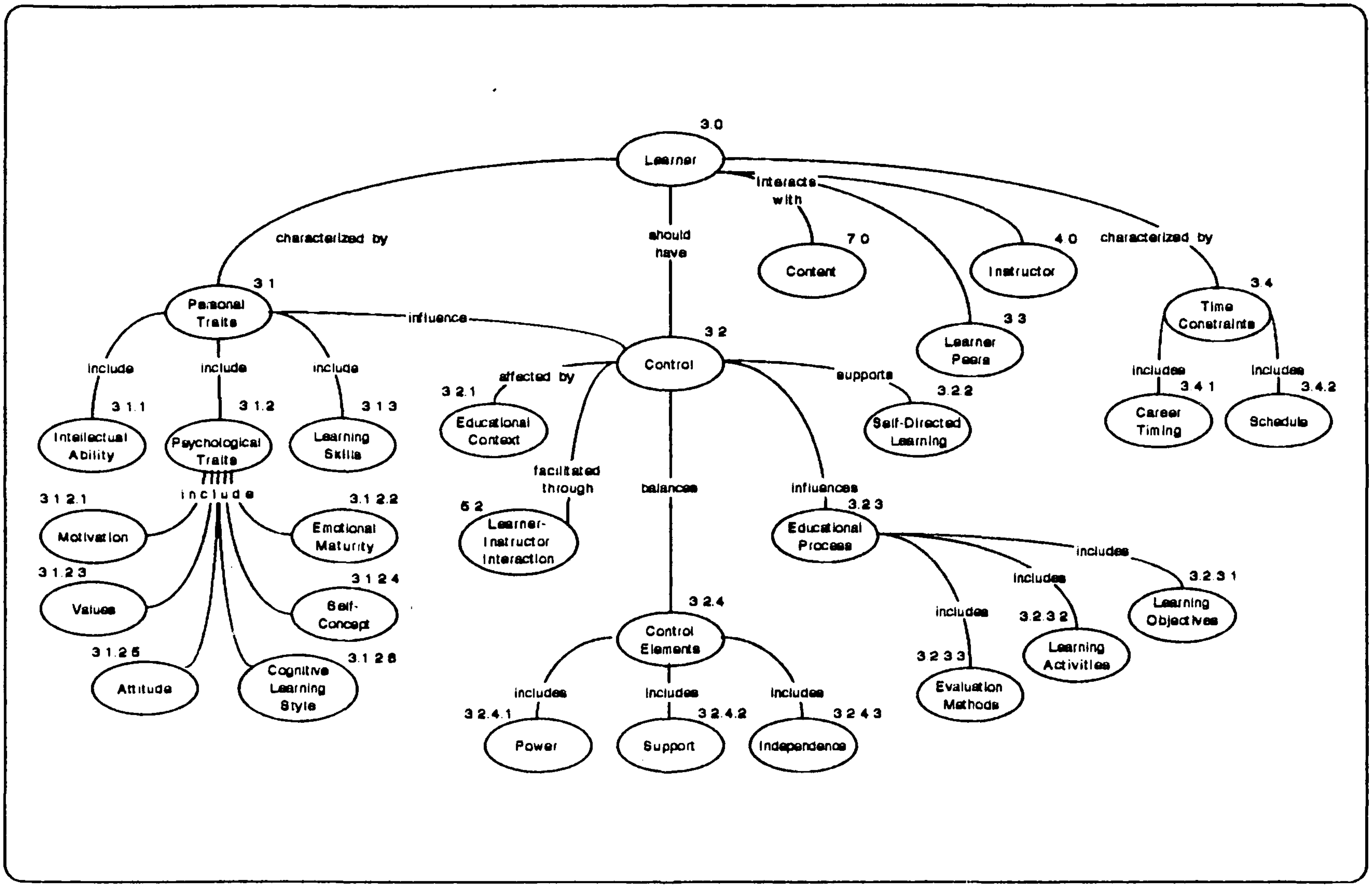

Figure B.4 (Map 4) Learner

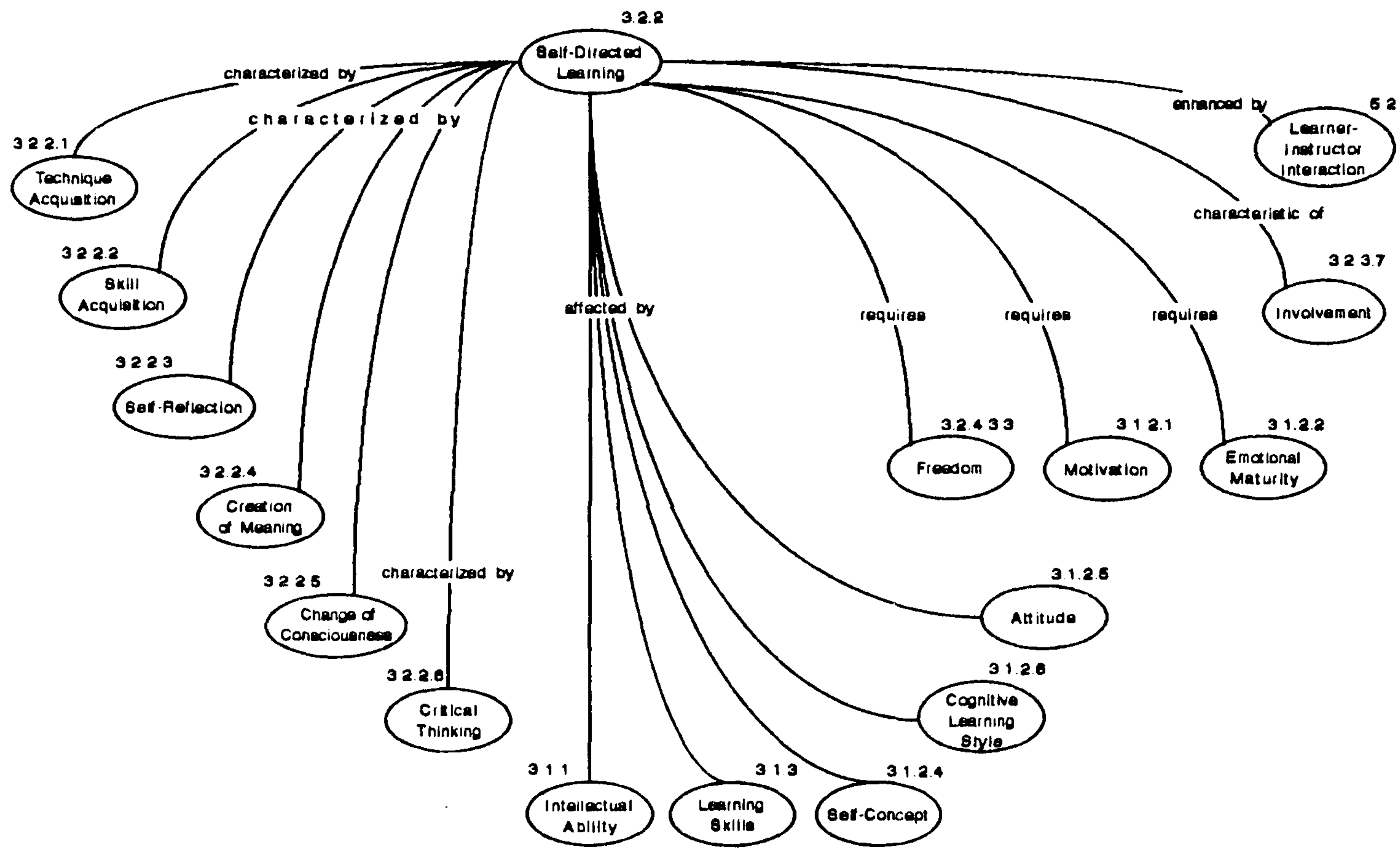

Figure B.5 (Map 5) Self-Directed Learning

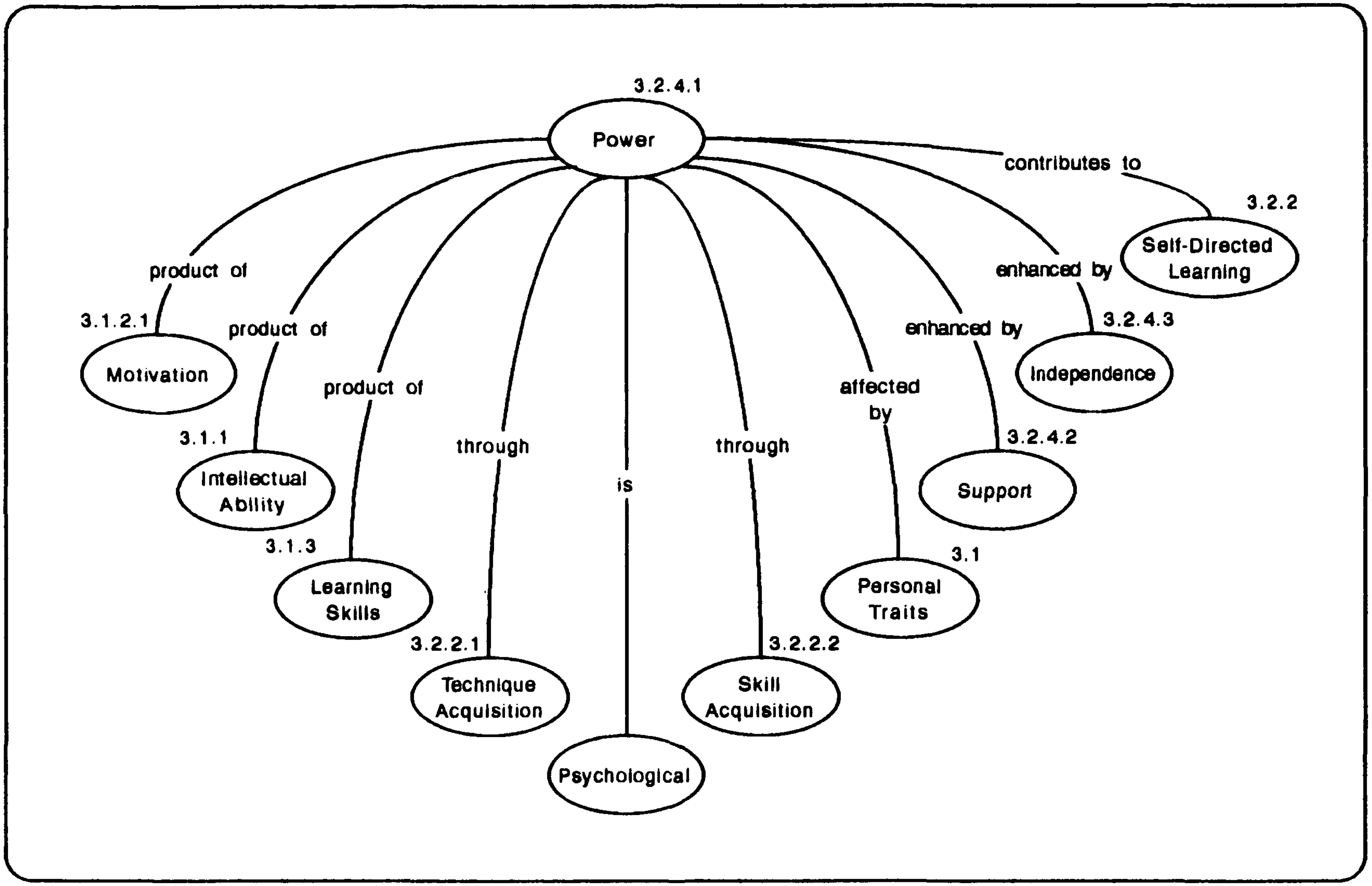

Figure B.6 (Map 6) Power

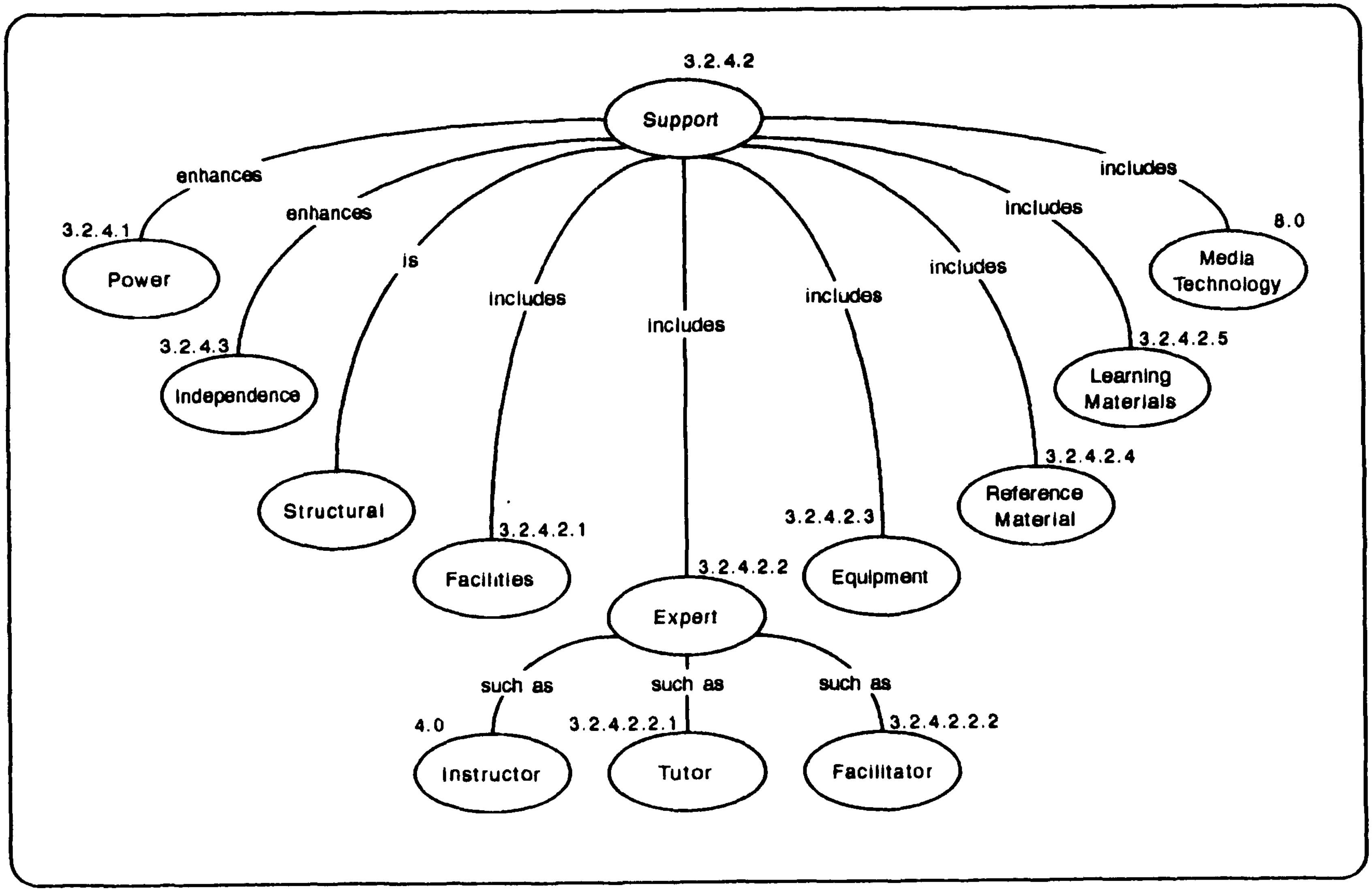

Figure B.7 (Map 7) Support

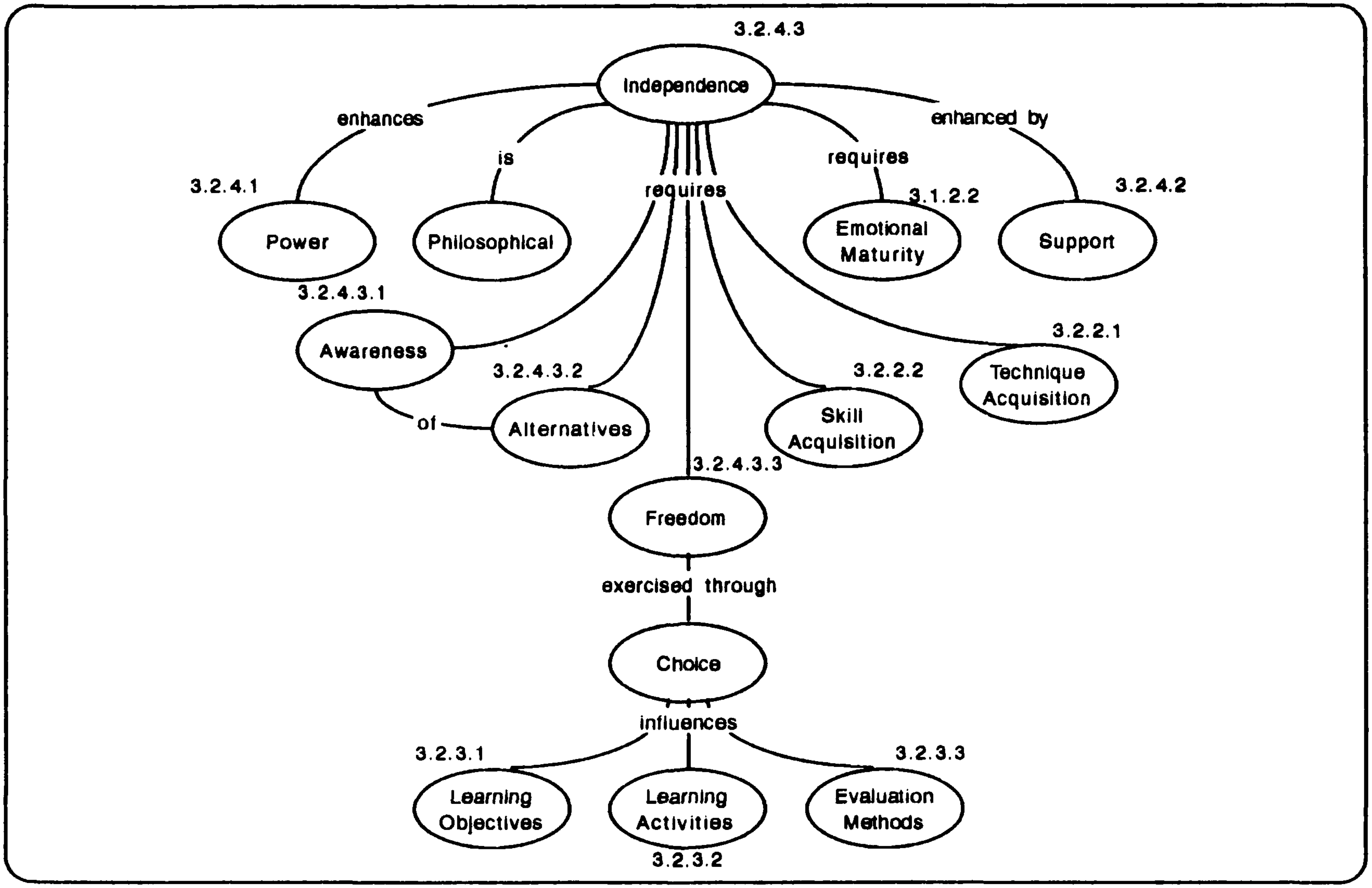

Figure B.8 (Map 8) Independence

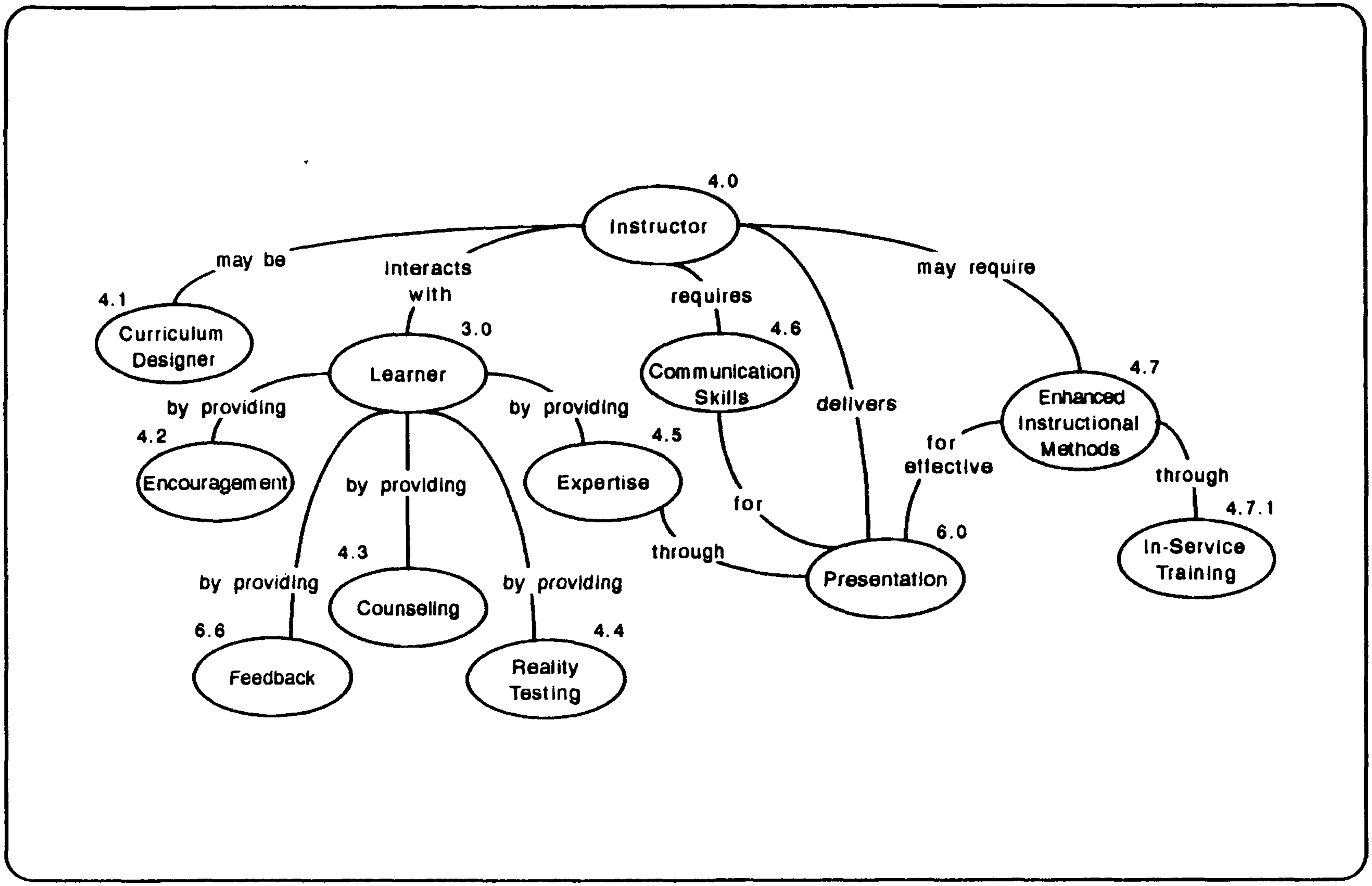

Figure B.9 (Map 9) Instructor

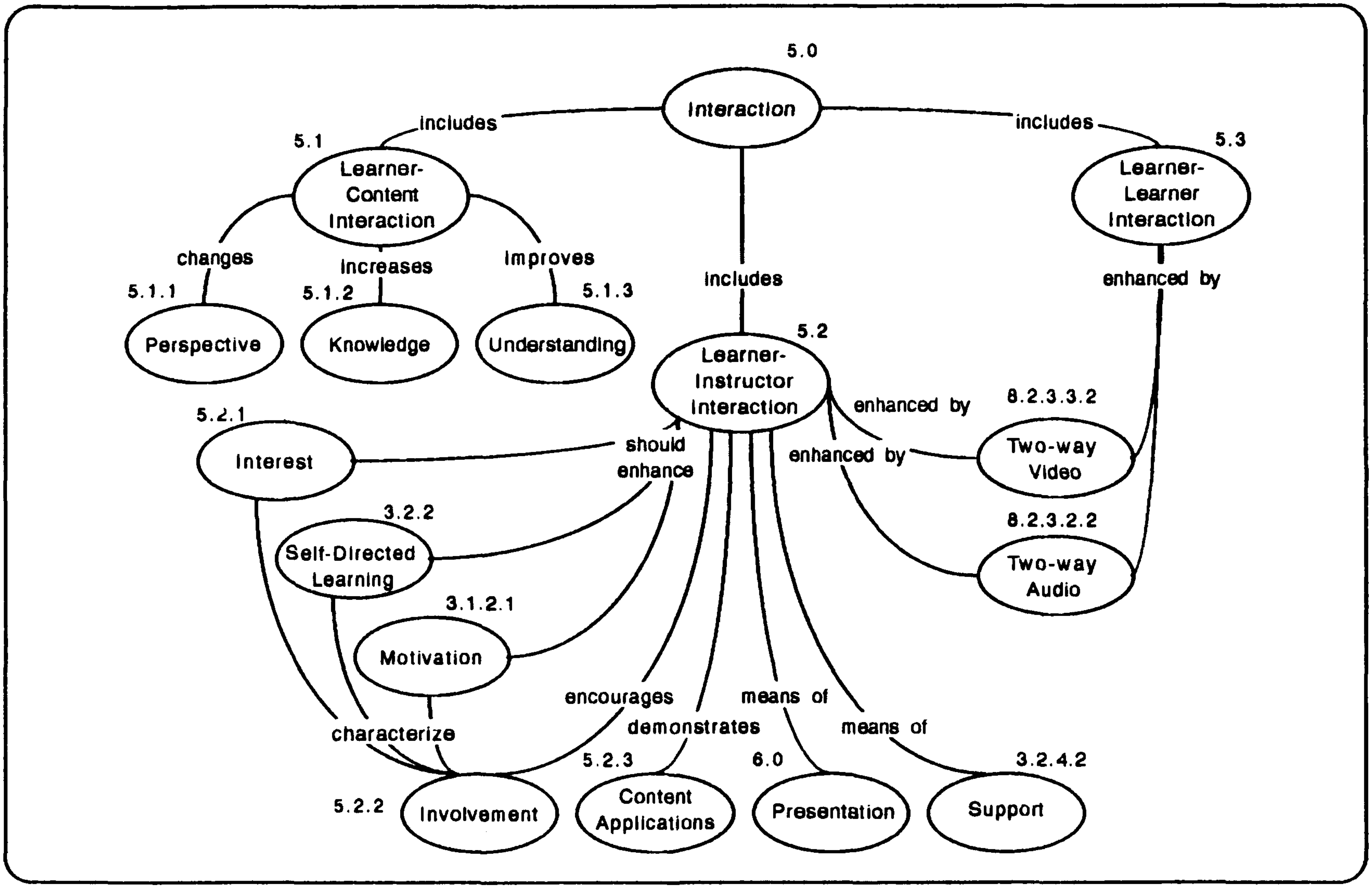

Figure B.10 (Map 10) Interaction

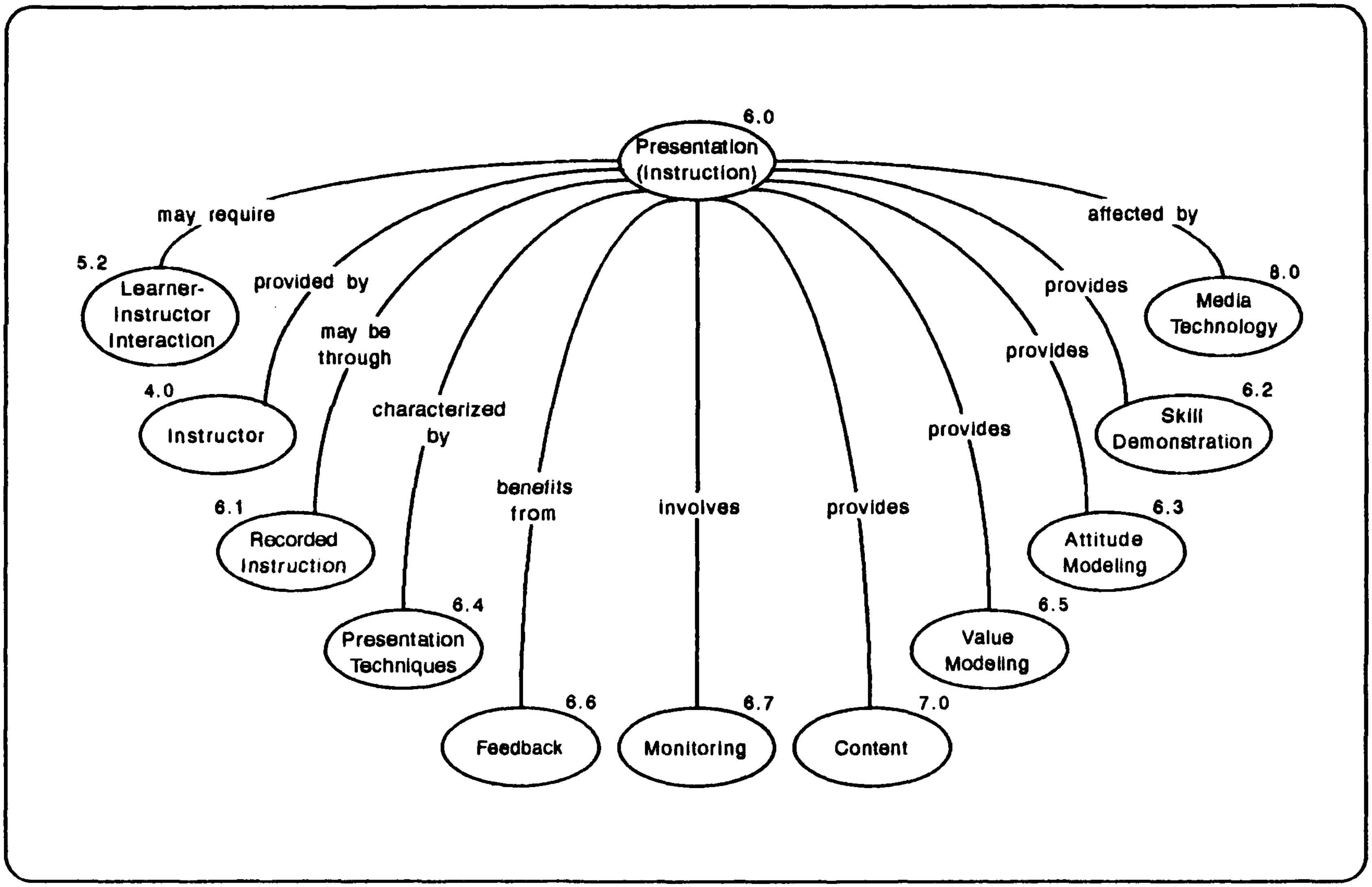

Figure B.11 (Map 11) Presentation

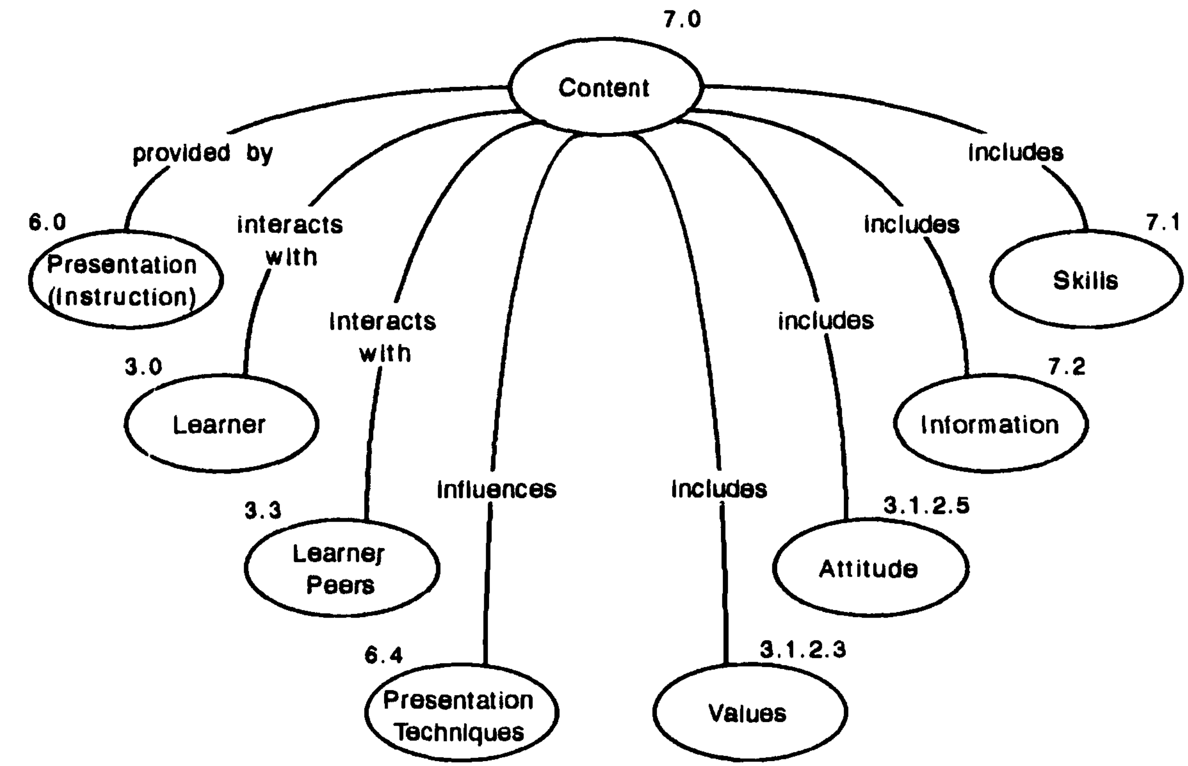

Figure B.12 (Map 12) Content

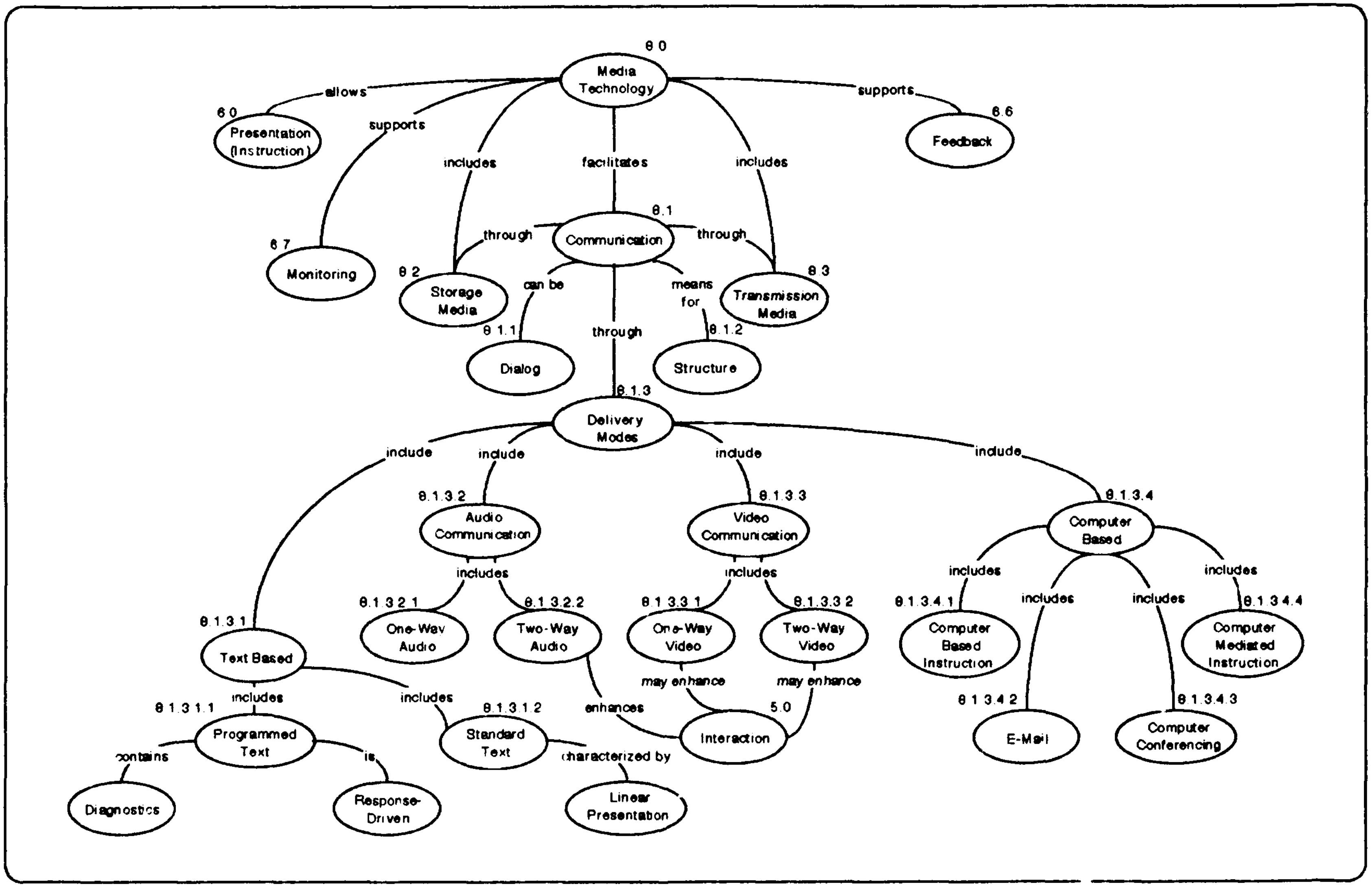

Figure B.13 (Map 13) Media Technology

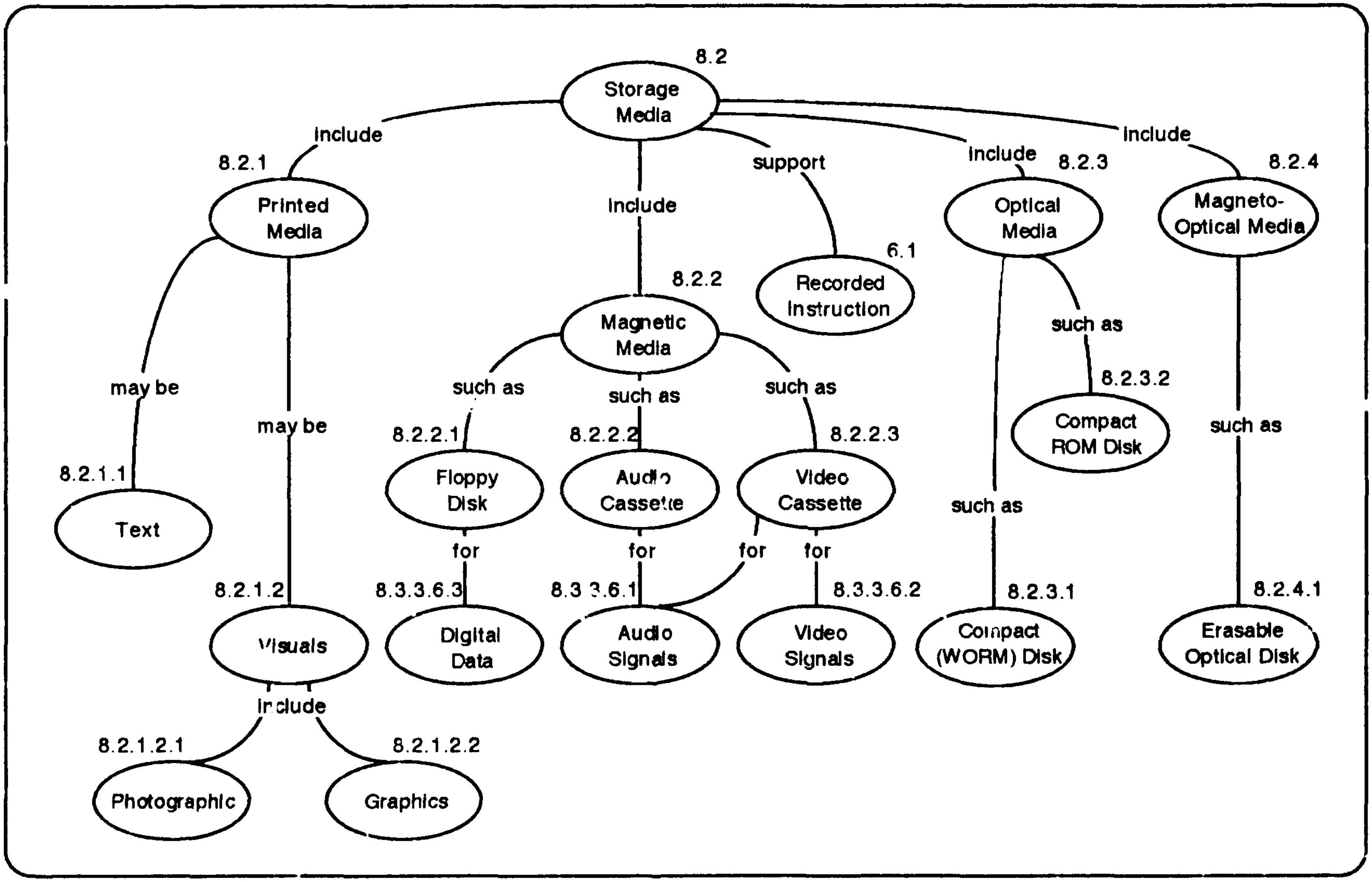

Figure B.14 (Map 14) Storage Media

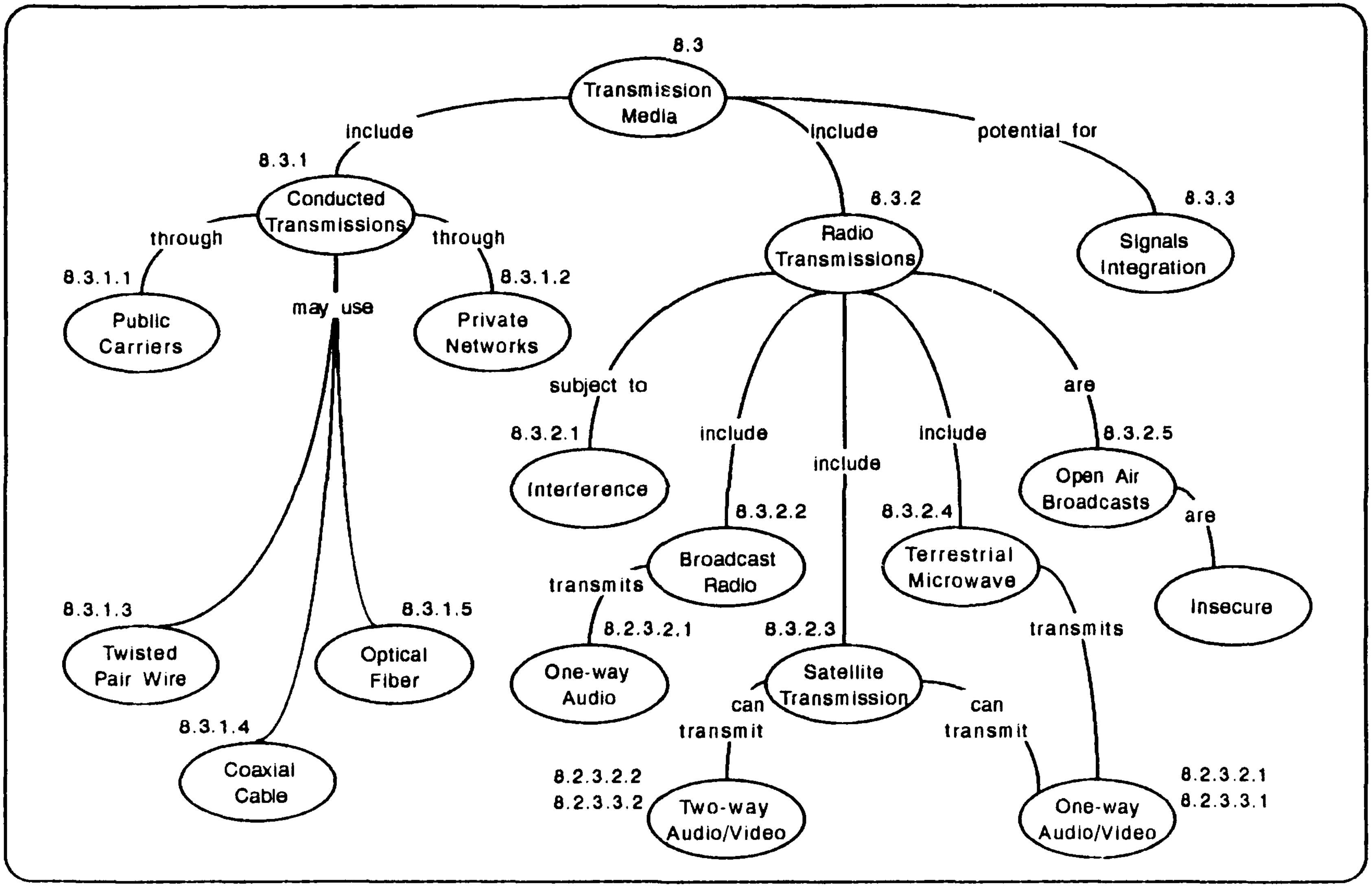

Figure B.15 (Map 15) Transmission Media

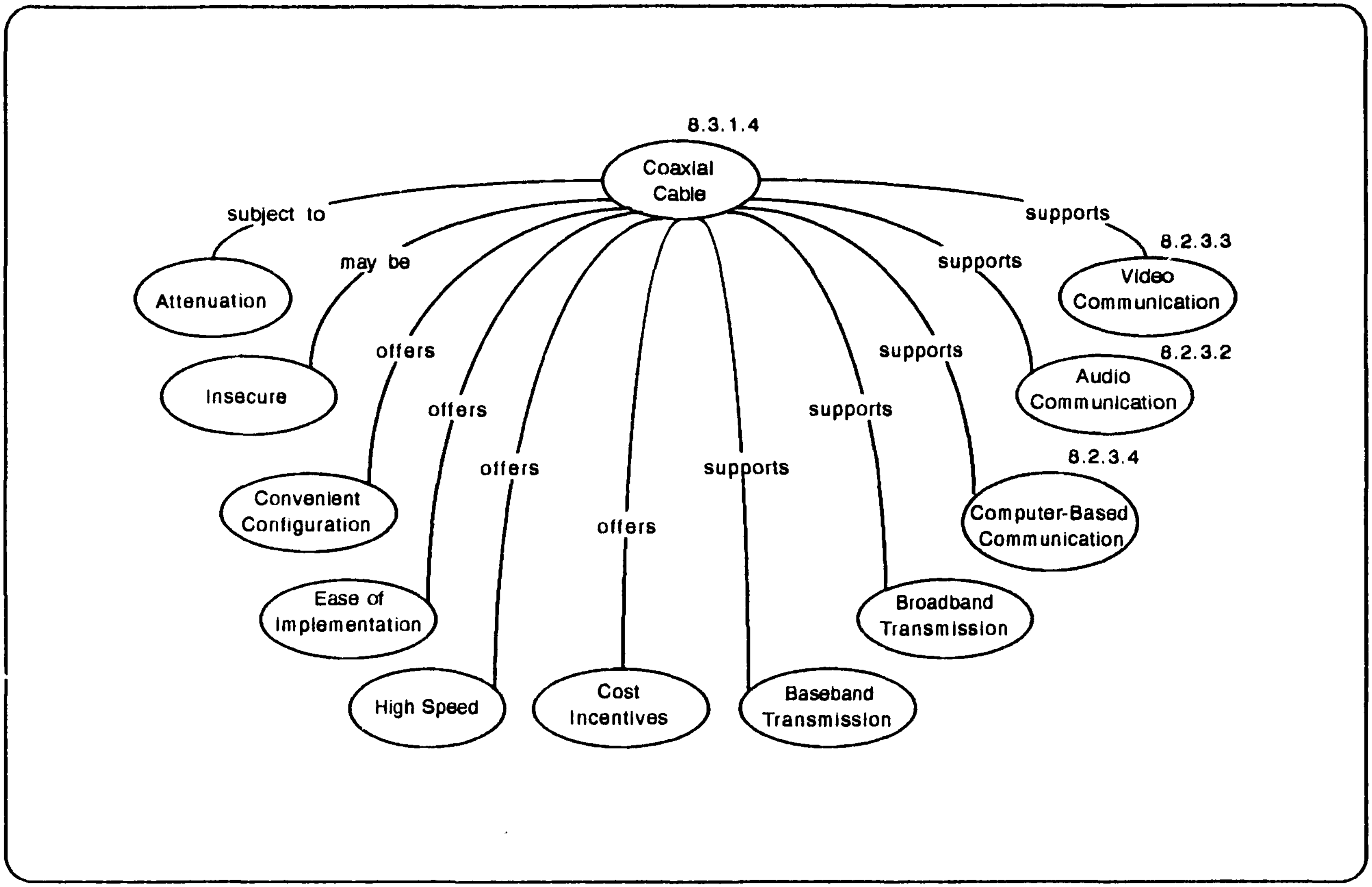

Figure B.16 (Map 16) Coaxial Cable

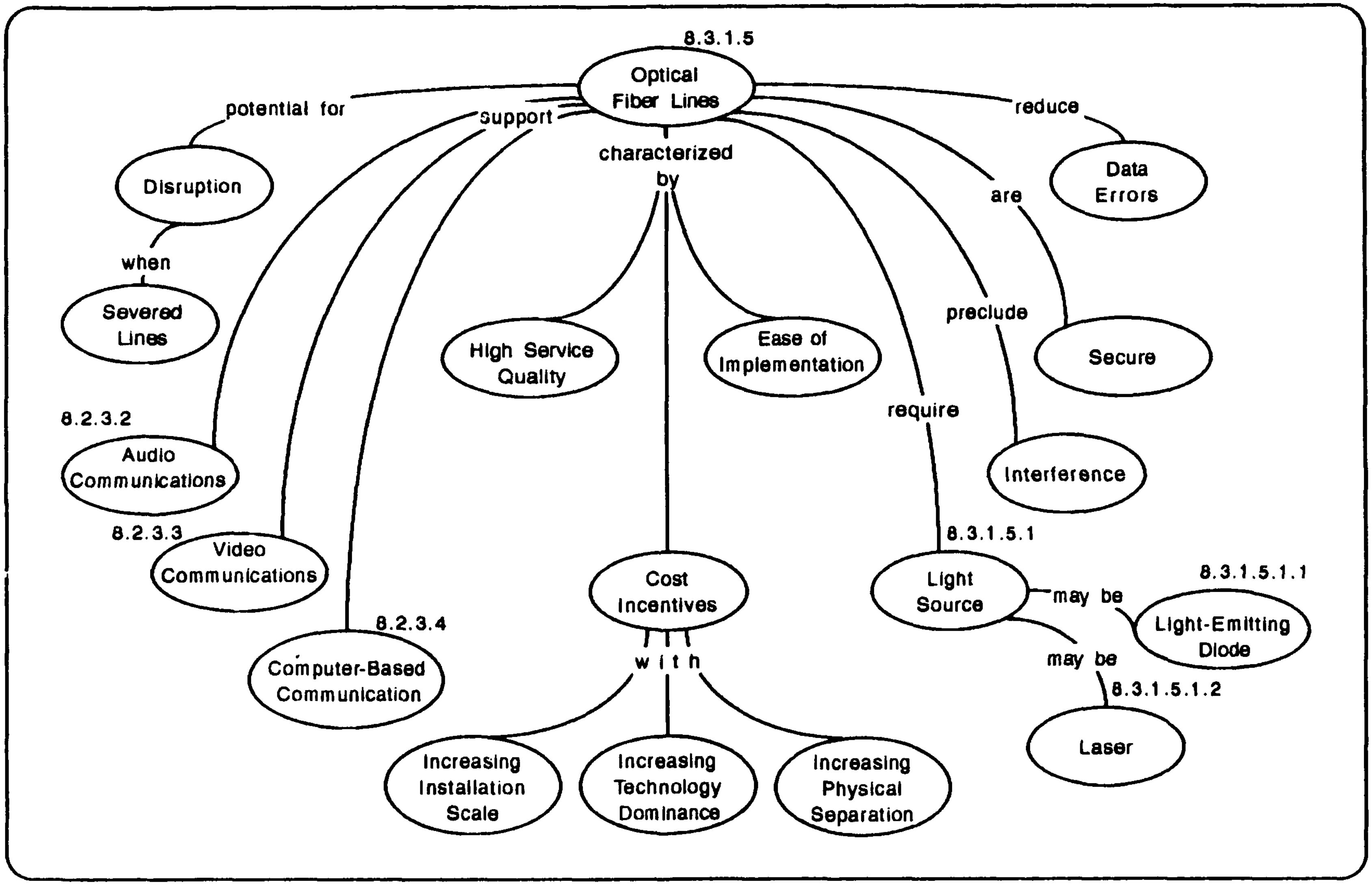

Figure B.17 (Map 17) Optical Fiber Lines

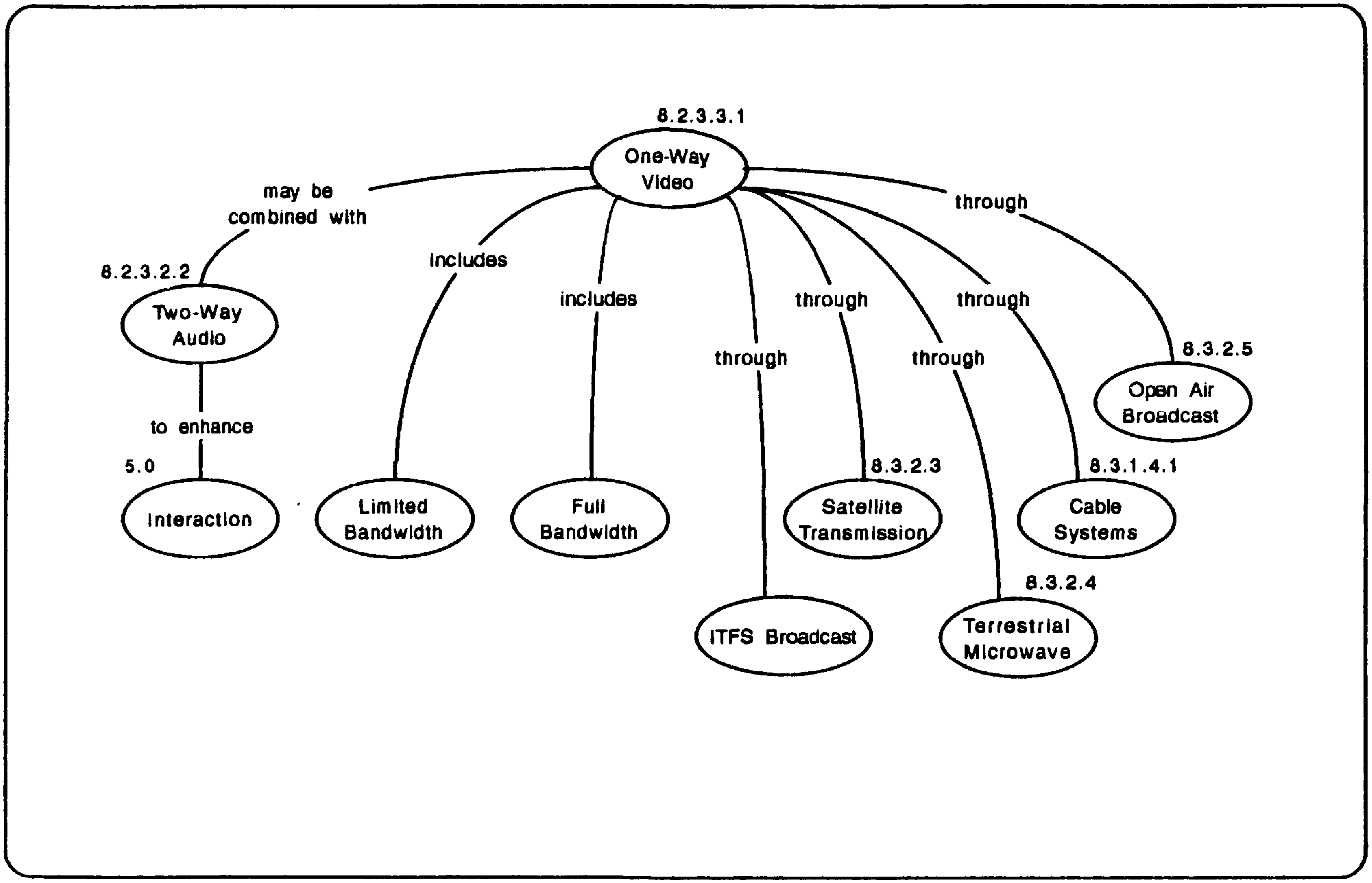

Figure B.18 (Map 18) One-Way Video

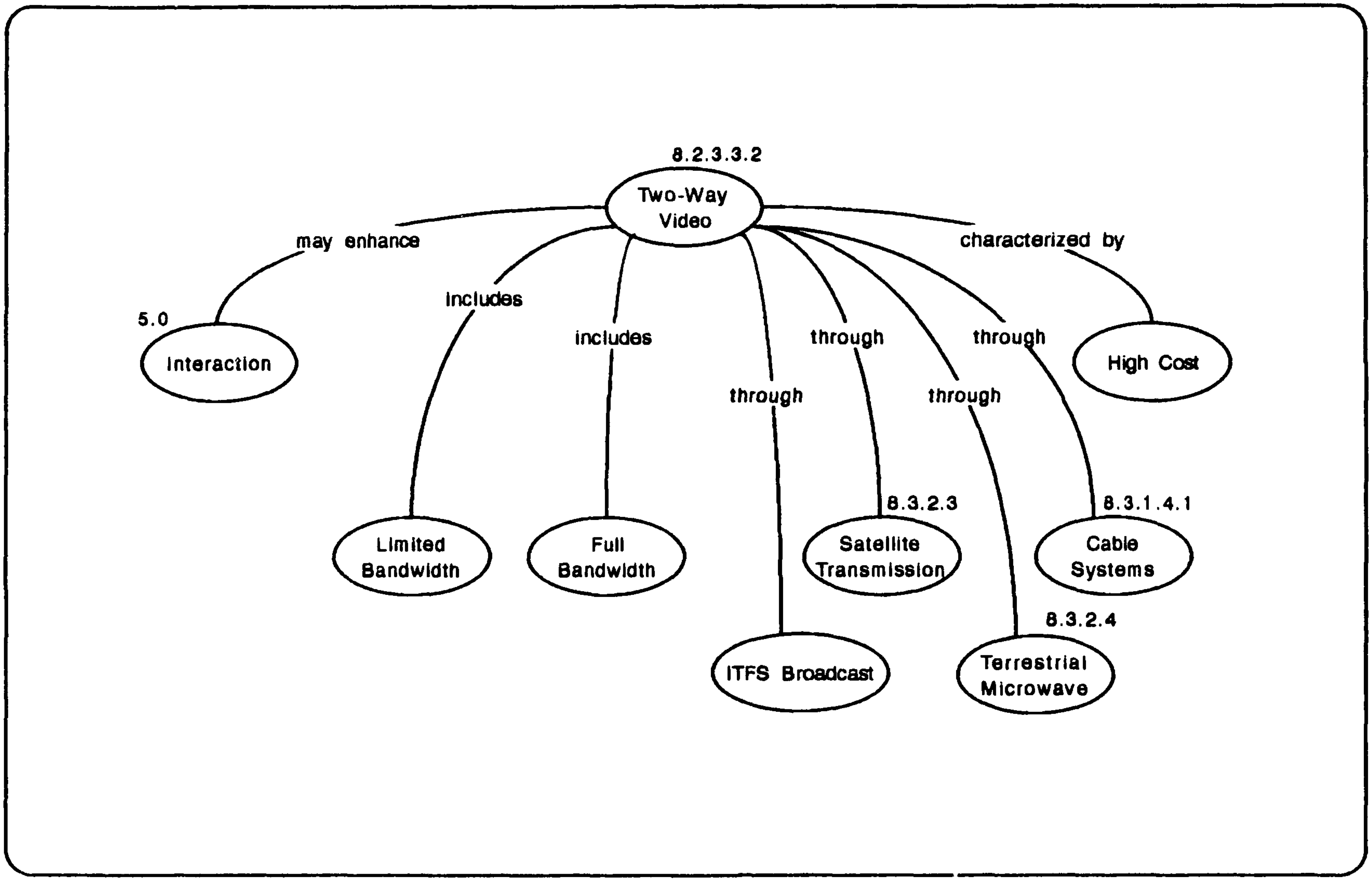

Figure B.20 (Map 20) Two-Way Video

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13. ABSTRACT (Maximum 200 words)

This research developed an approach for adapting a resident graduate course, offered by the School of Systems and Logistics, for delivery to remote students through distance education resources and techniques. A review of literature—along with personal interviews of professionals from the fields of education, telecommunications, and technology—provided the information for a model of distance education and an assessment of AFIT's existing and near future resources that may be applied to distance delivery of graduate courses. Semantic network construction software was used to organize the information gathered for the distance education model. Key concepts were distilled from the conceptually multi-dimensional semantic network and presented in two-dimensional, hierarchical concept maps. The distance education model presented concept maps of key concepts with text highlighting these concepts and organized in keeping with the structure reflected in the concept maps. AFIT's Academic Instructional System (AIS) provided a general procedural guideline for the design and development of graduate instruction. The research integrated knowledge of distance education—reflected in the distance education model—knowledge of AFIT's existing and near future resources, the AIS process, and cognitive activities into a course adaptation approach. The approach was demonstrated by application to a representative graduate course.

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